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SANTA CLARA VALLEY WATER DISTRICT

CALABAZAS CREEK

Conceptual Alternatives Report

Project No. 26104001

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Appendix

1. Introduction

Purpose of Report

The purpose of this report is to describe the Conceptual Alternatives for Flood Protection, Erosion Control, and Channel Restoration strategies developed for the Calabazas Creek Planning Study project (see Figure 1.1 – Watershed Map). Alternative A (no project) and six constructible Conceptual Flood Protection Alternatives (alternatives B, C, D, E, F, and G) are examined in this report. All six constructible alternatives are evaluated in this report with regards to the project objectives, technical feasibility, right-of-way availability, and cost constraints.

Conceptual Flood Protection Alternatives that pass the appropriate screening process based on project objectives, cost, and right of way availability will be identified as feasible alternatives that will undergo further analysis.

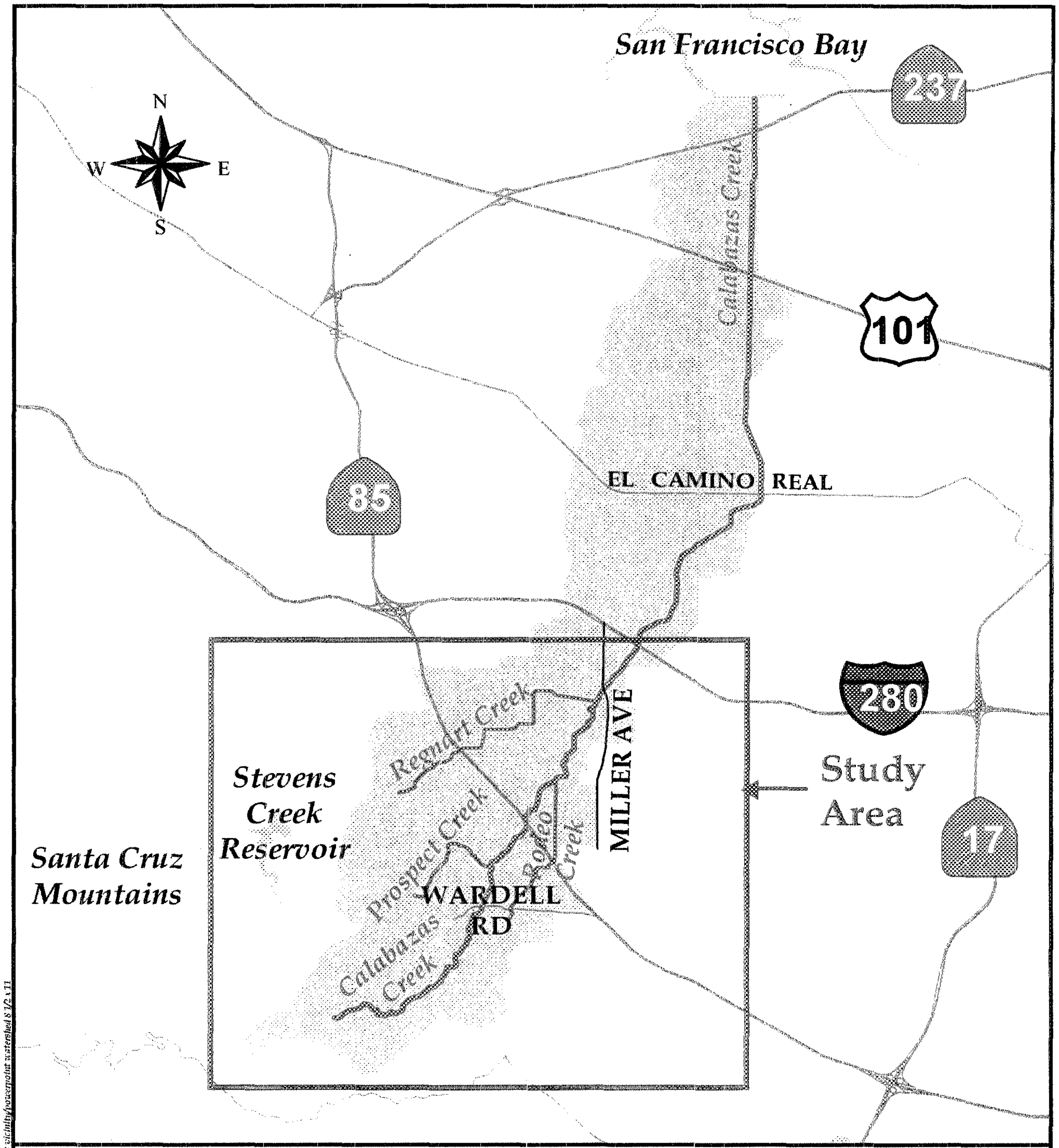
Problem Definition

Recurrent flooding and erosion along Calabazas Creek presents a long–term hazard to public safety, property values, and economic stability in the Cities of Cupertino, San Jose, and Saratoga. Hydraulic computer models have identified four locations where flood flows overtop channel banks during the 1% storm. The UPRR culvert and Saratoga-Sunnyvale Road underground tunnel are both submerged with pressure flow during the 1% flood. These two submerged waterways contribute to two of the four creek segments which currently experience flooding during a 1% storm (see Figure 1.2). The extensive erosion of the creek bank jeopardizes residential and public lands by encroaching on property lines, park areas, right-of-ways, and established channel confines within the project limits. See the August 2005 *Project Background/Problem Definition Report* for more details. In addition to flooding and bank erosion, creek restoration is another component that will be addressed within this study.

Project Objectives

As part of the Clean, Safe Creeks and Natural Flood Protection Program (projects funded by the voter-approved Measure B), the Santa Clara Valley Water District (District) initiated the Calabazas Creek Planning Study to provide flood protection, erosion control, and channel restoration from Miller Avenue to Wardell Road.

The project objectives are directly tied to the problem definition and represent the targeted/desired future conditions for the project area (see Figure 1.3). The project objectives provide the fundamental building blocks for identifying, developing, and evaluating the project alternatives. The objectives of the Creek Planning Study project are as follows:



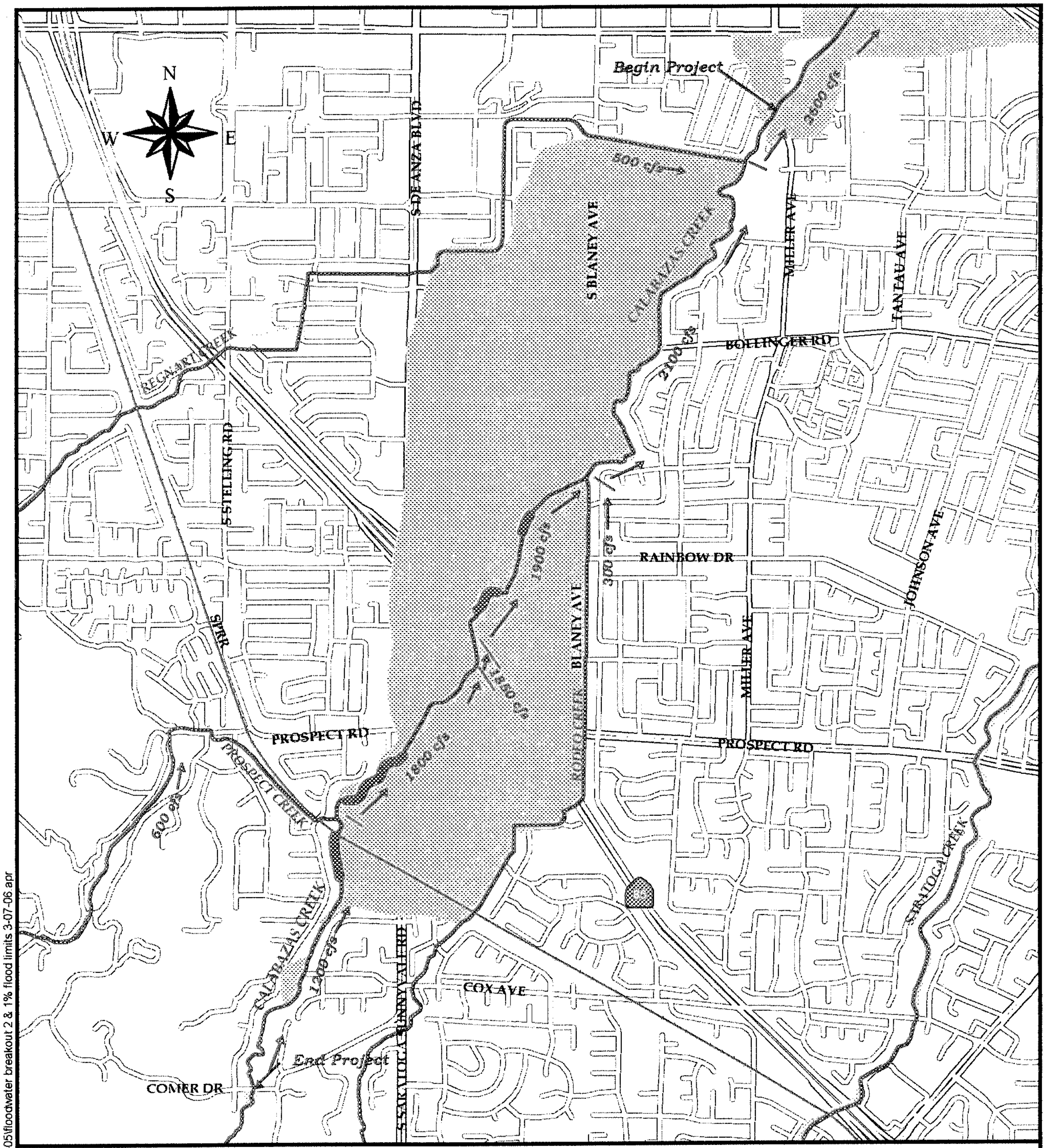
Calabazas Creek Watershed Map

Figure 1.1

Watershed Area ▨

1 0 1 Miles

Calabazas Creek/Miller to Wardell/project vicinity/powerpoint watershed 8 1/2 x 11



Calabazas Creek
Miller Ave. to Comer Dr.

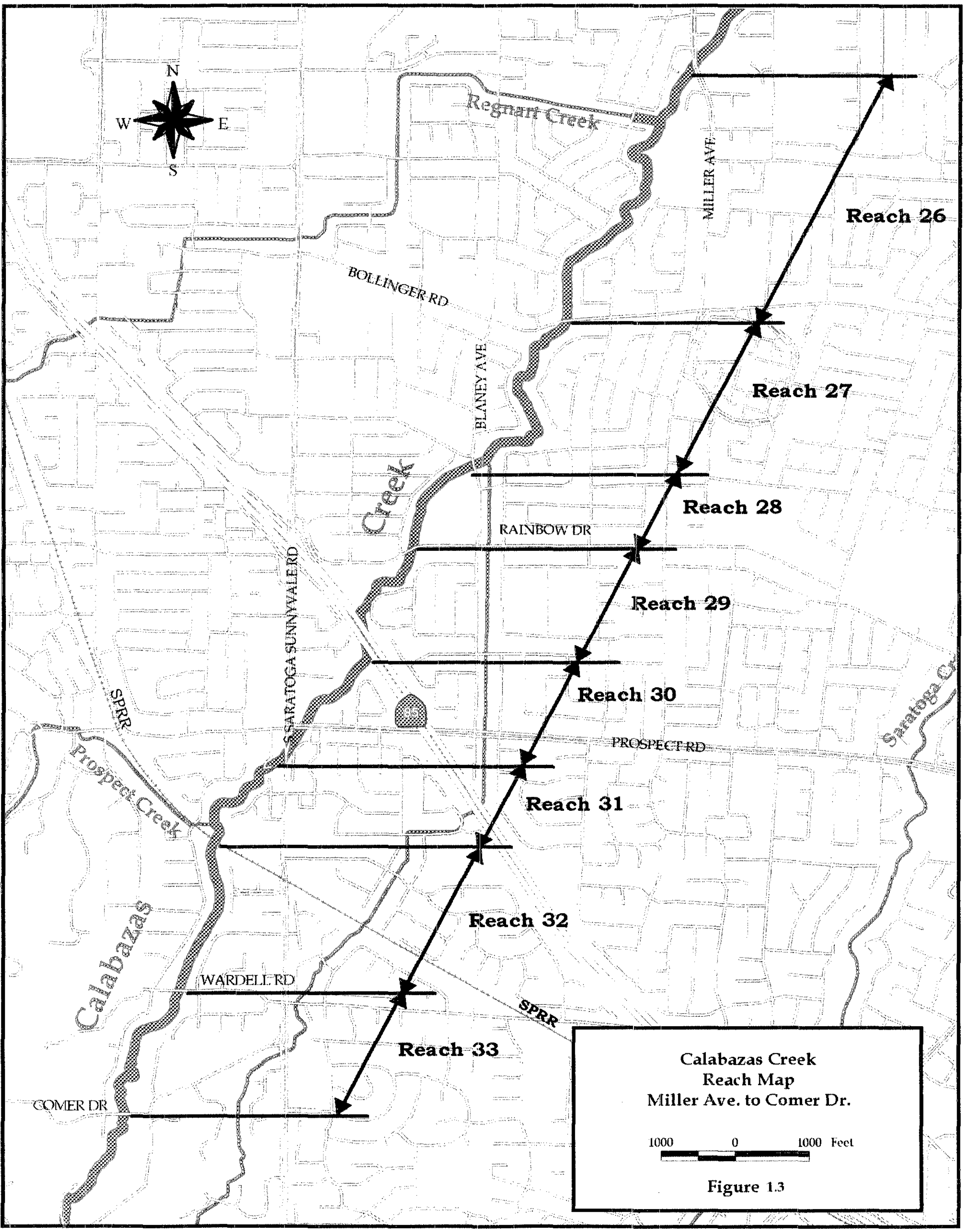
Figure 1.2

▨ **1% Flood Limits**

▨ **Floodwater Breakout Points**

0.25 0 0.25 Miles

Maria - O:Calabazas Creek\pari 3-3-05\floodwater breakout 2 & 1% flood limits 3-07-06 apr



Calabazas Creek
Reach Map
Miller Ave. to Comer Dr.

Figure 1.3

O:Calabazas Creek\Miller to Wardell\project vicinity\reach map 8 1/2 x 11

- While considering the entire watershed as a whole, develop a plan for the project reach that presents alternatives and a recommendation for providing flood protection for all flows up to the one-percent flood, erosion control and channel restoration for Calabazas Creek between Miller Avenue and Comer Drive by 10/30/2007

- Provide flood protection to 2,483 homes, businesses and schools upstream of Miller Avenue (Bollinger Road bridge will be re-built in 2007 under a separate project) from a one-percent (100-year) flood, preventing potential damages of $30.9 million by 12/31/2012.

- Address the necessity of repairing localized bank erosion because of its impact on water quality, ecological functions, or physical stream functions. Develop maintenance guidelines and obtain associated long-term permits to achieve these channel restoration objectives by 10/30/2007.

- Identify opportunities for environmental enhancement such as stream restoration, as well as trails, parks, and open space, for the Boards consideration by 10/30/2007.

Conceptual Flood Protection Alternatives

The aim of analyzing different Conceptual Flood Protection Alternatives is to investigate all reasonable ideas for meeting the project's objectives with regard to Flood Protection. Sufficient broad-scale detail has been provided so that the alternative's benefits, impacts, and costs could be roughly determined. A preliminary environmental review was conducted for each of the Conceptual Flood Protection Alternatives.

Each Conceptual Flood Protection Alternative is composed of one or more Conceptual Flood Protection Alternative Elements "Es" (See table 1.1). There are 13 elements "Es" in all, each of which is a unique element contributing towards meeting the flood protection objectives. The elements "Es" that make up each alternative are listed, a short explanation of what will be protected is given, and descriptions of scheduling, neighborhood impacts, feasibility, accessibility, cost, environmental, and maintenance benefits and concerns is given. The Conceptual Flood Protection Alternative Elements and how they would function are described in detail in Attachment A. Conceptual Flood Protection Alternatives Elements Costs are detailed in Attachment B.

Erosion Control

Erosion sites are identified and classified by level of severity. Erosion work is proposed using historically proven methods to address the problem in a natural aesthetically pleasing manner. The specific erosion methods used will be those selected by District staff based on experience with previous District erosion work. Biological and aesthetic sensitivity will be key factors in the decision process to select the erosion control method used at each individual site in the construction project. Four repair techniques are outlined in this report.

To gain a better understanding of the processes influencing erosion within the project reach, the District has designed a program of field work involving sediment transport analysis. By measuring both the suspended sediment and bedload transported during high flow events, we are developing a sediment rating curve and an historical archive of information used to understand and quantify the creek morphology taking place within the project reach in an effort to design more global erosion control measures.

Bioengineering techniques are the favored approach to erosion control. As with the seven flood protection alternatives, the erosion mitigation measures considered suitable by the District are presented for public review and comment.

The list of erosion sites to be repaired may change in later phases of the planning process based on public input, further sediment transport analysis results, and the amount of funds available in the project budget.

Channel Restoration

Flood Protection and Erosion Control work will be done in a manner sensitive to the local biological community and aesthetic needs of the local residents. Some of the channel restoration techniques and features proposed include:

- Removal of non-native species
- Native vegetation planting
- Creation of instream structure
- Removal of barrier to wildlife
- Comer Debris Basin Modification

The District is considering any restoration effort that will improve the environmental quality and ecology of Calabazas Creek. The Comer Debris Basin is considered aesthetically detrimental to the creek by local residents who are aware that it no longer performs any useful function. Because of this, modification or removal of the whole basin is considered in this Conceptual Alternative Report.

Also included in Channel Restoration are our ongoing geomorphic analyses. This Planning Study will include sediment transport analyses and a study of the natural geomorphic tendencies of the Calabazas Creek within the project limits. Both natural flood protection and erosion control plans will take Calabazas Creek geomorphology into full consideration.

Environmental Impact

Potential environmental impact was originally intended as a Level 1 screening criterion, but preliminary environmental review of the Conceptual Flood Protection Alternatives concluded that there would be no significant environmental impacts that would preclude alternatives from moving forward into the feasible alternative analysis phase. Therefore, potential environmental impacts were not used to screen Conceptual Flood Protection Alternatives. Results of the preliminary environmental review are included in Attachment D to support the District's decision to not use it as a Level 1 screening criterion.

ELEMENTS (E)	CONCEPTUAL FLOOD PROTECTION ALTERNATIVES						
	A	B	C	D	E	F	G
E1: Construct Levee / Floodwall at Calabazas Park	NO PROJECT				X		
E2: Widen Channel at Calabazas Park		X	X	X		X	
E3: Contruct Levee / Floodwall upstream, downstream of Foot Bridge		X	X	X	X	X	
E4: Raise Existing Foot Bridge		X					
E5: Relocate Foot Bridge			X	X	X	X	
E6: Construct a Bypass Pipe along Saratoga-Sunnyvale Rd Tunnel		X					
E7: Construct Additional Tunnel along Saratoga-Sunnyvale Rd Tunnel				X	X		
E8: Replace Saratoga-Sunnyvale Tunnel by (9' x 24')			X			X	
E9: Construct Levee / Floodwall upstream Saratoga-Sunnyvale Rd Tunnel		X	X	X	X	X	
E10: Replace UPRR Culvert by (6' x 23')				X	X	X	
E11: Construct Levee / floodwall u/s of UPRR				X	X	X	
E12: Construct a Bypass Pipe along Creek Bank at UPRR		X	X				
E13: Non-Structural (Flood Proofing)							X

Table 1.1

2. Conceptual Flood Protection Alternative Descriptions

Each Conceptual Flood Protection Alternative is made of one or more Conceptual Flood Protection Elements "Es" within the project reach. Each Conceptual Flood Protection Alternative Element "E" is described in detail in Attachment A and Cost Analysis for each element in detail in Attachment B of this report. Each Conceptual Flood Protection Alternative description in this section of the report is presented in the following format:

- Conceptual Flood Protection Alternative Name
- Alternative Description (Includes "E" descriptions)
- Screening Analysis
- Construction Schedule
- Temporary Local Neighborhood Impacts
    - Public Services and Utilities
    - Traffic
- Technical Feasibility
- Land Ownership/Access
- Costs
- Preliminary Environmental Review (identifies any sensitive issues)
- Operation and Maintenance
- Conclusion

Conceptual Flood Protection Alternative A (No Project)

Alternative Description

Under Conceptual Flood Protection Alternative A no new project elements would be implemented in the study area (see Figure 2.1). Flood flows would continue to overtop channel banks and inundate adjacent properties, resulting in flood-related damages to residences, businesses and schools. Bank slope erosion would be protected as needed and maintenance practices would be continued.

Conceptual Flood Protection Alternative A is composed of no element.

Screening Analysis

This alternative does not meet the Calabazas Creek Project objectives, but will be considered as part of the Conceptual Flood Protection Alternative environmental analysis.

Construction Schedule

No construction required.

Temporary Local Neighborhood Impacts

None

Technical Feasibility

N/A

Land Ownership / Access

No issues expected.

Costs

Construction costs would be $0.0

Maintenance costs as described below would be approximately $ 55,200 annually (Emergency erosion repairs are excluded).

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

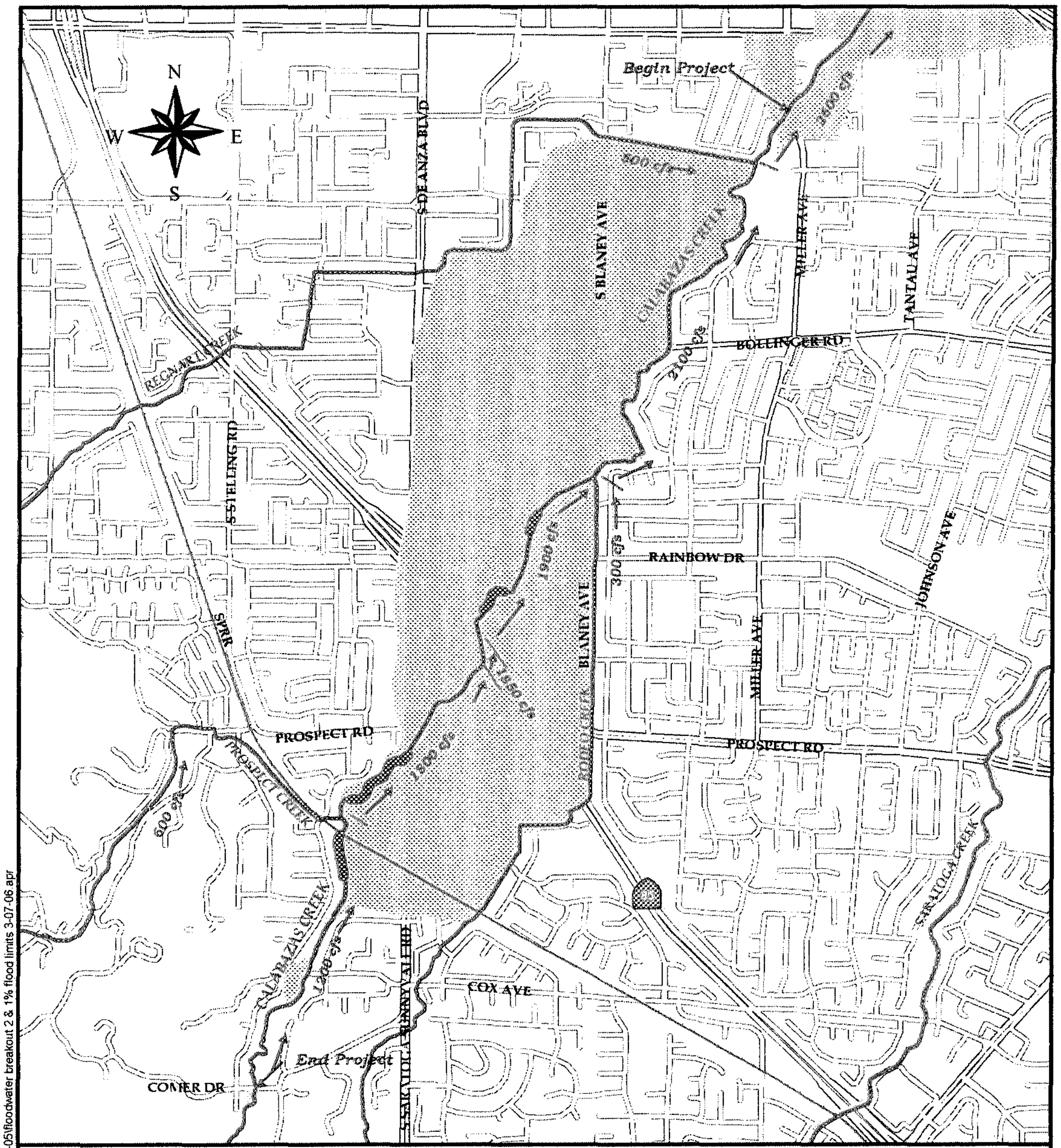
Current operations and maintenance practices would continue. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal of Comer debris basin.

Conclusion

Alternative A does not impose any new costs but does not address the flood issues of Calabazas Creek.

Alternative A
No Project

Leave creek in it's existing state.



Calabazas Creek
Miller Ave. to Comer Dr.

Figure 2.1

▨ 1% Flood Limits

▨ Floodwater Breakout Points

0.25 0 0.25 Miles

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Conceptual Flood Protection Alternative B

Alternative Description

This alternative combines channel widening, levees or floodwalls, raising an existing footbridge, and two bypass pipe elements to increase the capacity of all project reaches to the design flows (see Figure 2.2). Conceptual Flood Protection Alternative B is composed of the following elements "Es":

Provisions for Alternative B are listed below in order from the most downstream point in this alternative to the most upstream point. See Attachment A for complete details.

***E2: Channel Widening at Calabazas Park** (approx. STA 483+80 to STA 489+73)*

Between Blaney Avenue and Rainbow Drive, this 600-foot channel section through Calabazas Park would be enlarged.

***E3: Levee/Floodwall d/s and u/s of Footbridge** (approx. STA 498+36 to STA 503+35)*

Beginning from approx. 300-feet downstream of the footbridge and continuing for 200 feet u/s of the footbridge, construction of a levee / floodwall on the east bank.

***E4: Raising Existing Footbridge** (approx. STA 501+36 to STA 501+42)*

East side of the footbridge located downstream of HWY 85 would be raised to the same elevation as the right bank. This footbridge provides access to the Cupertino Creekside Apartment pool which is located on the east side of the creek.

***E6: Saratoga-Sunnyvale Bypass Pipe** (approx. STA 525+11 to STA 531+94)*

An underground bypass provided by a 7-foot diameter concrete circular box would be constructed along the existing box culvert from Prospect Road to Saratoga-Sunnyvale Road.

***E9: Levee/Floodwall u/s Saratoga-Sunnyvale** (STA 531+94 to STA 535+89)*

Build a levee / floodwall on the right bank upstream of the Saratoga-Sunnyvale Road Culvert for approx. 400-feet.

***E12: UPRR Bypass pipe along Creek Bank** (approx. STA 547+68 to STA 549+80)*

An underground bypass consisting of a 6-foot diameter concrete circular culvert under residential backyard would be constructed. The outlet from the structure would start from a point 60-feet downstream of the Union Pacific Rail Road (UPRR) crossing and continue south along the creek bank to a point 120-feet upstream of UPRR.

Conceptual Alternative Screening Analysis

This alternative would satisfy the project objectives in the following ways:

- Protect 2,483 parcels from a one-percent flood.
- Protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.

- Protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- Protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- Protect business developments, as well as keep the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would be protected from a one-percent flood by fully containing flows within the creek.
- Provide opportunities for a continuous maintenance corridor along the creeks by including space for suitable maintenance access.
- Protect the watershed's current environmental resources, accommodates environmental enhancements, and will not preclude new recreational opportunities.

Construction Schedule

Construction and installation of the two bypasses would be completed in 1 to 2 construction seasons, depending on the difficulties relocating existing utilities located beneath the local roadways and along the railroad. The channel widening next to Calabazas Park, the levee/floodwall construction, and the footbridge raising would all require 1 construction season.

Temporary Local Neighborhood Impacts

- ***Public Services and Utilities:***
  Construction activities could interrupt or disturb public services and utilities. Existing underground utilities are located beneath roadways in construction area. Implementation may require relocation and/or temporary disruption of some existing utilities.
- ***Traffic:***
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. In addition, traffic using bridges in the project area could be affected by construction activities.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership/Access

Construction of the UPRR bypass along the creek bank would require flood control easements. Land acquisition would be necessary for the bypass route. Construction access easements may be necessary. The new bypass along Saratoga-Sunnyvale Road would be constructed on the left side within SCVWD easement. All other works would occur within the existing District easements or fee properties.

Costs

Construction cost for the entire alternative would be: $ 3,125,000.

Yearly maintenance cost would be: $ 41,860 .

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the UPRR bypass would be minimal. The bypass would be designed to have adequate slope for sediment passage.

Operation and maintenance of the Saratoga-Sunnyvale bypass would be minimal. Although the Saratoga-Sunnyvale bypass would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

Conclusion

Construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project. The estimated capital cost of this alternative would be within the acceptable limit for further consideration and review as a feasible alternative. ***Therefore, this alternative will be carried forward into the feasibility analysis.***

Alternative B

E2 **Widen Channel at Calabazas Park**

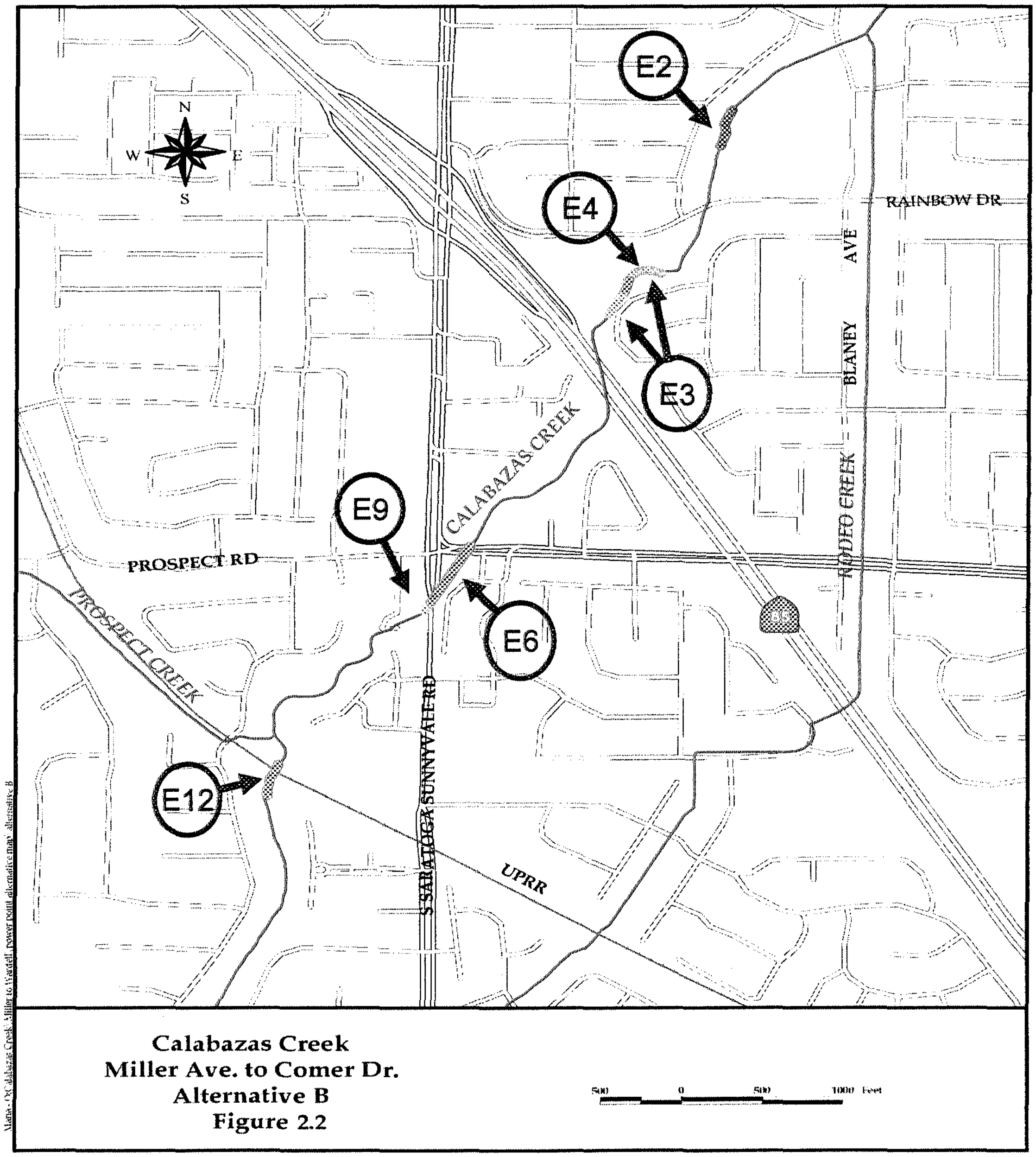
E3 **Construct Levee/Floodwall Downstream and Upstream of Footbridge**

E4 **Raise Existing Footbridge**

E6 **Construct a Bypass Pipe Along Saratoga-Sunnyvale Road Tunnel**

E9 **Construct Levee/Floodwall Upstream of Saratoga-Sunnyvale Road Tunnel**

E12 **Construct a Bypass Pipe Along Creek Bank at Union Pacific Railroad**



Calabazas Creek
Miller Ave. to Comer Dr.
Alternative B
Figure 2.2

Maria - O:\Calabazas Creek\Miller to Wardell\power point alternative map\alternative B

Conceptual Flood Protection Alternative C

Alternative Description

This alternative combines channel widening, levees or floodwalls, relocation of an existing footbridge, culvert replacement, and bypass pipe installation elements to increase the capacity of all project reaches to the design flows (see Figure 2.3). Conceptual Flood Protection Alternative C is composed of the following elements "Es":

Provisions for Alternative C are listed below in order from the most downstream point in this alternative to the most upstream point. See Attachment A for complete details.

E2: Channel Widening at Calabazas Park *(approx. STA 483+80 to STA 489+73)*

Between Blaney Avenue and Rainbow Drive, this 600-foot channel section through Calabazas Park would be enlarged.

E3: Levee/Floodwall d/s of Footbridge *(approx. STA 498+36 to STA 503+35)*

Beginning at a point 400 feet downstream of the footbridge (relocated) and ending at the footbridge, construction of a levee / floodwall on the right bank.

E5: Footbridge Relocation *(approx. STA 502+35 to STA 502+42)*

The footbridge located downstream of HWY 85 would be removed and relocated approximately 100 feet upstream of the existing location. This footbridge provides access to the Cupertino Creekside Apartment pool which is located on the east side of the creek.

E8: Saratoga-Sunnyvale Tunnel Replacement *(approx. STA 525+11 to STA 531+94)*

The existing 9-foot by 14-foot underground concrete tunnel with a length of approximately 650 feet from Prospect Road to Saratoga-Sunnyvale Road would be demolished and replaced by a new 9-foot by 24-foot underground tunnel.

E9: Levee/Floodwall u/s Saratoga-Sunnyvale *(approx STA 531+94 to STA 535+89)*

Build a levee / floodwall on the right bank upstream of the Saratoga-Sunnyvale Road tunnel for approx. 400-feet.

E12: UPRR Bypass Pipe Along Creek Bank *(approx. STA 547+68 to STA 549+80)*

An underground bypass consisting of a 6-foot diameter concrete circular culvert under residential backyard property would be constructed. The inlet to the structure would start from 120-feet upstream of UPRR and continue north along the creek bank to point 60-feet downstream of the Union Pacific Rail Road (UPRR) crossing.

Conceptual Alternative Screening Analysis

This alternative would satisfy the project objectives in the following ways:

- Protect 2,483 parcels from a one-percent flood.
- Protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.
- Protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- Protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- Protect business developments, as well as keep the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would be protected from a one-percent flood by fully containing flows within the creek.
- Provide opportunities for a continuous maintenance corridor along the creeks by including space for suitable maintenance access.
- Protect the watershed's current environmental resources, accommodates environmental enhancements, and will not preclude new recreational opportunities.

Construction Schedule

Construction and installation of the bypass at UPRR would be completed in 1 to 2 construction seasons, depending on the difficulties relocating existing utilities located along the railroad. Expansion of the Saratoga-Sunnyvale underground tunnel is also expected to last 1 to 2 construction seasons. The channel widening at Calabazas Park, the levee/floodwall construction and the footbridge relocation could all be completed in one construction season.

Temporary Local Neighborhood Impacts

- ***Public Services and Utilities:***
  Construction activities could interrupt or disturb public services and utilities. Existing underground utilities are located beneath roadways in construction area. Implementation may require relocation and/or temporary disruption of some existing utilities.
- ***Traffic:***
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and

bike lanes during construction. In addition, traffic using bridges in the project area could be affected by construction activities.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership/Access

Construction of the UPRR bypass along the creek bank would require flood control easements. Land acquisition would be necessary for the bypass route. Construction access easements may be necessary. All other works would occur within the existing District easements or fee properties.

Costs

Construction cost for the entire alternative would be: $ 5,483,000.

Yearly maintenance cost would be: $ 41,860.

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the bypass would be minimal. The UPRR bypass would be designed to have adequate slope for sediment control.

Operation and maintenance of the new Saratoga-Sunnyvale Road tunnel would be similar to existing tunnel. Although the Saratoga-Sunnyvale Road tunnel would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

Conclusion

Construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project. The estimated capital cost of this alternative would be within the acceptable limit for further consideration and review as a feasible alternative. ***Therefore, this alternative will be carried forward into the feasibility analysis.***

Alternative C

E2 **Widen Channel at Calabazas Park**

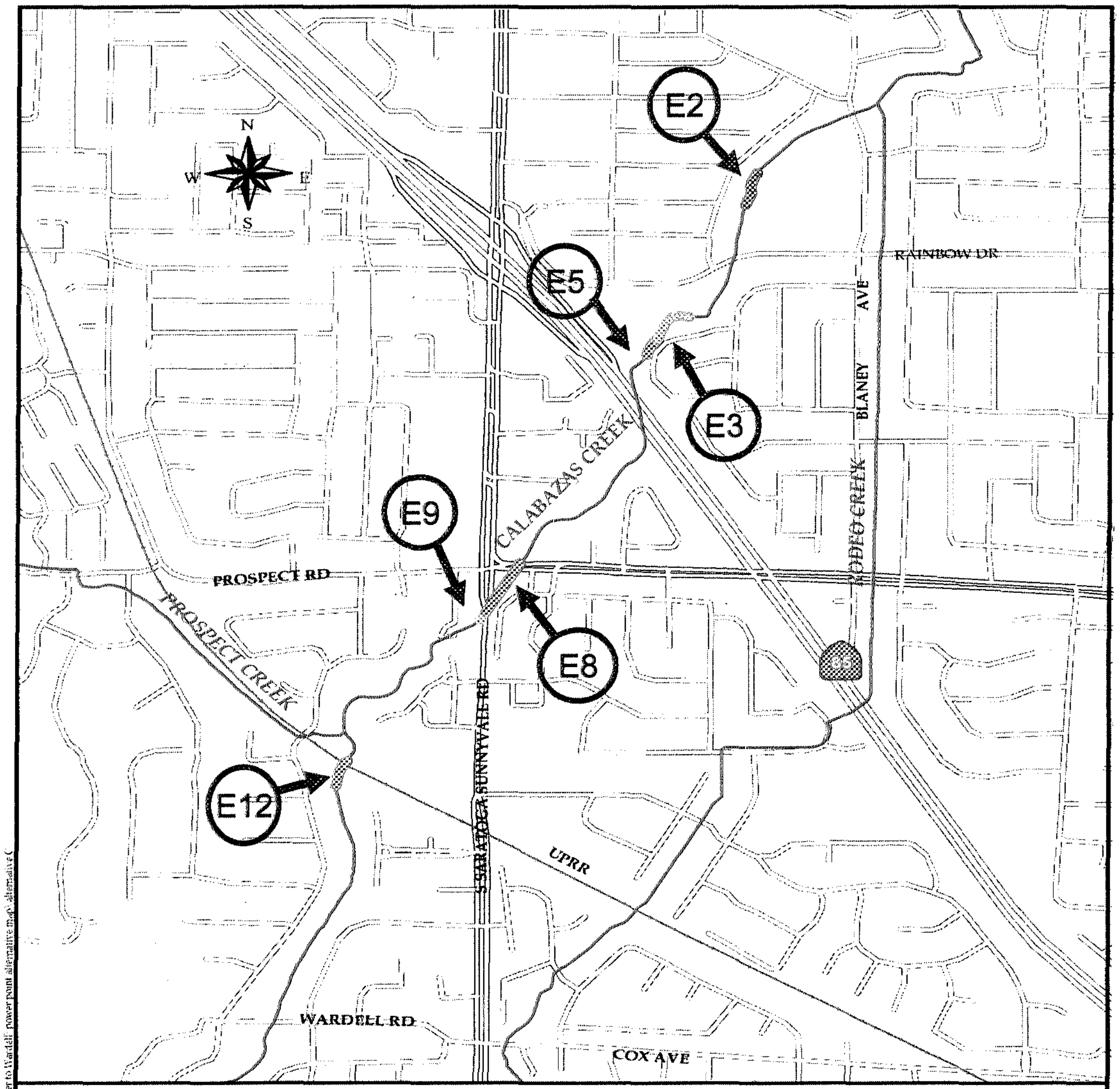
E3 **Construct Levee/Floodwall Downstream of Footbridge**

E5 **Relocate Footbridge**

E8 **Replace Saratoga-Sunnyvale Road Tunnel**

E9 **Construct Levee/Floodwall Upstream of Saratoga-Sunnyvale Road Tunnel**

E12 **Construct a Bypass Pipe Along Creek Bank at Union Pacific Railroad**



Calabazas Creek
Miller Ave. to Comer Dr.
Alternative C
Figure 2.3

Maria O:Calabazas Creek Miller to Wardell power point alternative map\ alternative C

Conceptual Flood Protection Alternative D

Alternative Description

This alternative combines channel widening, levees or floodwalls, relocation of an existing footbridge, culvert addition, and culvert replacement elements to increase the capacity of all project reaches to the design flows (see Figure 2.4). Conceptual Flood Protection Alternative D is composed of the following elements "Es":

Provisions for Alternative D are listed below in order from the most downstream point in this alternative to the most upstream point. See Attachment A for complete details.

***E2: Channel Widening at Calabazas Park** (approx. STA 483+80 to STA 489+73)*

Between Blaney Avenue and Rainbow Drive, this 600-foot channel section through Calabazas Park would be enlarged.

***E3: Levee/Floodwall d/s of Footbridge** (approx. STA 498+36 to STA 503+35)*

Beginning at a point 400 feet downstream of the footbridge (relocated) and ending at the footbridge, build a levee / floodwall on the right bank.

***E5: Footbridge Relocation** (approx. STA 502+35 to STA 502+42)*

The footbridge located downstream of HWY 85 would be removed and relocated approximately 100 feet upstream of the existing location. This footbridge provides access to the Cupertino Creekside Apartment pool which is located on the east side of the creek.

***E7: Saratoga-Sunnyvale Additional Tunnel** (approx. STA 525+11 to STA 531+94)*

A 9-foot by 14-foot underground concrete tunnel would be constructed to the left side of the existing 9-foot by 14 foot underground concrete tunnel with a length of approximately 650 feet from Prospect Road to Saratoga-Sunnyvale Road.

***E9: Levee/Floodwall u/s Saratoga-Sunnyvale** (approx. STA 531+94 to STA 535+89)*

Build a levee / floodwall on the right bank upstream of the Saratoga-Sunnyvale Road underground tunnel for approx. 400-feet.

***E10: UPRR Culvert Replacement** (approx. STA 548+28 to STA 548+63)*

The existing 6-foot by 13-foot concrete box culvert would be demolished and replaced by a new 6-foot by 23-foot culvert.

***E11: Levee/Floodwall construction u/s UPRR** (approx. STA 549+05 to STA 549+80)*

Build a levee / floodwall on both banks for a distance of 150 feet upstream of UPRR.

Conceptual Alternative Screening Analysis

This alternative would satisfy the project objectives in the following ways:

- Protect 2,483 parcels from a one-percent flood.
- Protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.
- Protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- Protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- Protect business developments, as well as keep the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would be protected from a one-percent flood by fully containing flows within the creek.
- Provide opportunities for a continuous maintenance corridor along the creeks by including space for suitable maintenance access.
- Protect the watershed's current environmental resources, accommodates environmental enhancements, and will not preclude new recreational opportunities.

Construction Schedule

Expansion of the UPRR culvert would be completed in 1 to 2 construction seasons, depending on the difficulties relocating existing utilities located along the railroad. Construction of an additional tunnel next to the Saratoga-Sunnyvale underground tunnel is also expected to require 1 to 2 construction seasons. The channel widening at Calabazas Park, the levee/floodwall construction and the footbridge relocation could all be completed in 1 construction season.

Temporary Local Neighborhood Impacts

- ***Public Services and Utilities:***
  Construction activities could interrupt or disturb public services and utilities. Existing underground utilities are located beneath roadways in the construction area. Implementation may require relocation and/or temporary disruption of some existing utilities.
- ***Traffic:***
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. In addition, traffic using bridges in the project area could be affected by construction activities.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership/Access

It is expected that the new tunnel under Saratoga-Sunnyvale Road would be constructed on the left side within SCVWD easement. All work on the Union Pacific Rail Road (UPRR) culvert would occur within the state of California (Caltrans) right-of-way and SCVWD easements. No land acquisition would be necessary from property owners for other works; they would occur within existing District easements or fee properties.

Costs

Construction cost for the entire alternative would be: $ 3,702,000.

Yearly maintenance cost would be: $ 41,860.

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the expanded UPRR culvert would be similar to existing culverts. The culverts would be designed to have adequate slope for sediment passage.

Operation and maintenance of the Saratoga-Sunnyvale additional tunnel would be similar to the existing underground tunnel. Although the Saratoga-Sunnyvale Road tunnel would be designed with adequate slope to move debris, the inlets would still require regular cleaning to remove leaves and other debris during the flow season.

Conclusion

Construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project. The estimated capital cost of this alternative would be within the acceptable limit for further consideration and review as a feasible alternative. ***Therefore, this alternative will be carried forward into the feasibility analysis.***

Alternative D

E2 Widen Channel at Calabazas Park

E3 Construct Levee/Floodwall Downstream of Footbridge

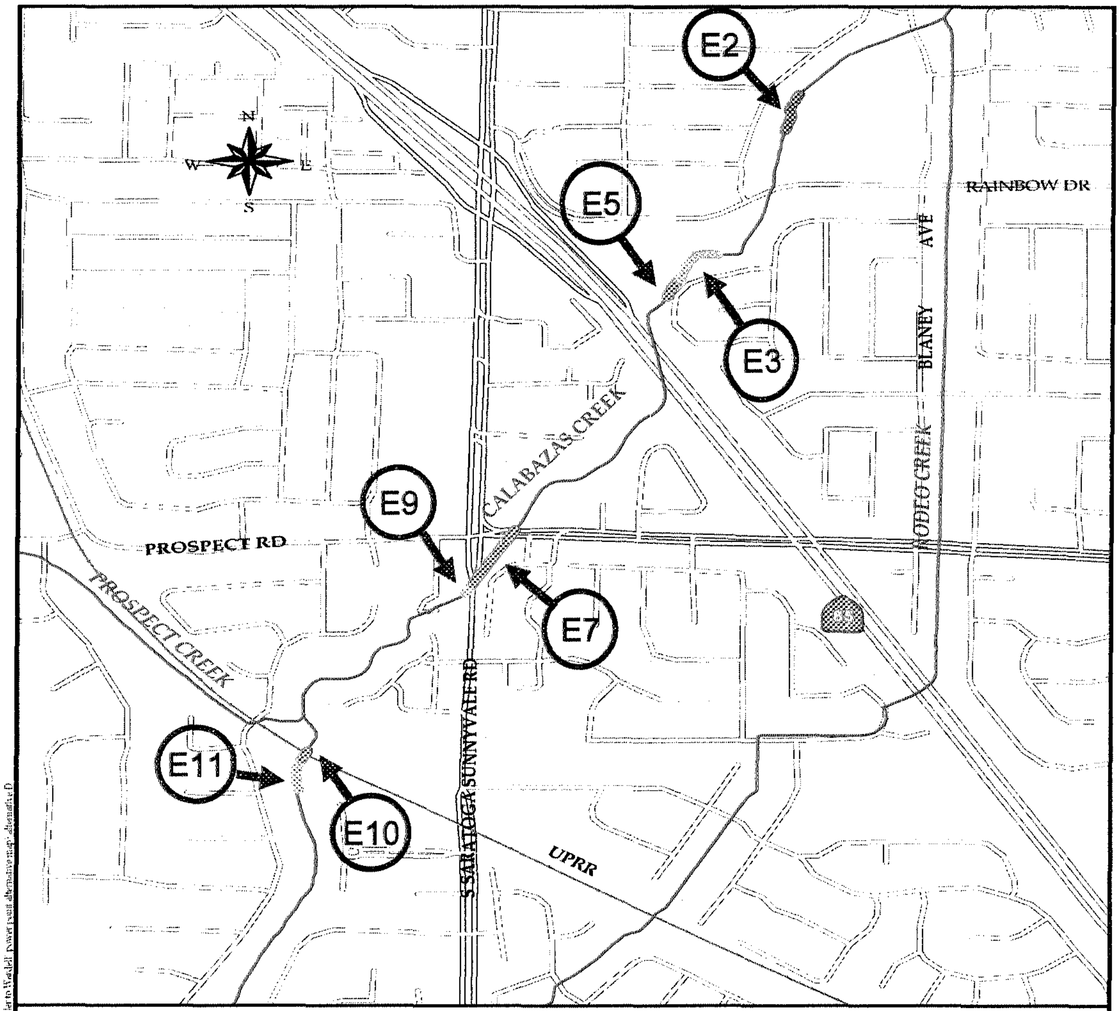
E5 Relocate Footbridge

E7 Construct Additional Tunnel Along Saratoga-Sunnyvale Road Tunnel

E9 Construct Levee/Floodwall Upstream of Saratoga-Sunnyvale Road Tunnel

E10 Replace Union Pacific Railroad Culvert

E11 Construct Levee/Floodwall Upstream of Union Pacific Railroad



Calabazas Creek
Miller Ave. to Comer Dr.
Alternative D
Figure 2.4

Conceptual Flood Protection Alternative E

Alternative Description

This alternative combines channel widening, levees or floodwalls, relocation of an existing footbridge, culvert addition, and culvert replacement elements to increase the capacity of all project reaches to the design flows (see Figure 2.5). Conceptual Flood Protection Alternative E is composed of the following elements "Es":

Provisions for Alternative E are listed below in order from the most downstream point in this alternative to the most upstream point. See Attachment A for complete details.

E1: Levee/floodwall at Calabazas Park *(approx. STA 485+80 to STA 489+73)*

Between Blaney Avenue and Rainbow Drive, this 400 foot channel section through Calabazas Park would be modified by constructing a levee / floodwall 3 to 4 feet in height atop the existing left bank (looking u/s).

E3: Levee/Floodwall d/s of Footbridge *(approx. STA 498+36 to STA 502+42)*

Beginning at a point 400 feet downstream of the footbridge (relocated) and ending at the footbridge, build a levee / floodwall atop the left bank (looking u/s).

E5: Footbridge Relocation *(approx. STA 502+35 to STA 502+42)*

The footbridge located downstream of HWY 85 would be removed and relocated approximately 100 feet upstream of the existing location. This footbridge provides access to the Cupertino Creekside Apartment pool which is located on the east side of the creek.

E7: Saratoga-Sunnyvale Additional Tunnel *(approx. STA 525+11 to STA 531+94)*

A 9-foot by 14-foot underground concrete tunnel would be constructed to the left side of the existing 9-foot by 14 foot underground concrete tunnel with a length of approximately 650 feet from Prospect Road to Saratoga-Sunnyvale Road.

E9: Levee/Floodwall u/s Saratoga-Sunnyvale *(approx. STA 531+94 to STA 535+89)*

Build a levee / floodwall on the right bank upstream of the Saratoga-Sunnyvale Road underground tunnel for approx. 400-feet.

E10: UPRR Culvert Replacement *(approx. STA 548+28 to STA 548+63)*

The existing 6-foot by 13-foot concrete box culvert would be demolished and replaced by a new 6-foot by 23-foot concrete box culvert.

E11: Levee/Floodwall u/s UPRR *(approx. STA 549+05 to STA 549+80)*

Build a levee / floodwall on both banks for a distance of 150 feet upstream of UPRR.

Conceptual Alternative Screening Analysis

This alternative would satisfy the project objectives in the following ways:

- Protect 2,483 parcels from a one-percent flood.
- Protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.
- Protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- Protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- Protect business developments, as well as keep the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would be protected from a one-percent flood by fully containing flows within the creek.
- Provide opportunities for a continuous maintenance corridor along the creeks by including space for suitable maintenance access.
- Protect the watershed's current environmental resources, accommodates environmental enhancements, and will not preclude new recreational opportunities.

Construction Schedule

Expansion of the UPRR culvert would be completed in 1 to 2 construction seasons, depending on the difficulties relocating existing utilities located along the railroad. Construction of additional tunnel next to the Saratoga-Sunnyvale underground tunnel is also expected to 1 to 2 construction seasons. The levee/floodwall construction and the relocation of the footbridge could all be completed in 1 construction season.

Temporary Local Neighborhood Impacts

- ***Public Services and Utilities:***
  Construction activities could interrupt or disturb public services and utilities. Existing underground utilities are located beneath roadways in construction area. Implementation may require relocation and/or temporary disruption of some existing utilities.
- ***Traffic:***
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. In addition, traffic using bridges in the project area could be affected by construction activities.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership/Access

It is expected the new tunnel under Saratoga-Sunnyvale Road would be constructed on the left side within SCVWD easement. All work on the Union Pacific Rail Road (UPRR) culvert would occur within the state of California (Caltrans) right-of-way and SCVWD easements. No land acquisition would be necessary from property owners for other works; they would occur within the existing District easements or fee properties.

Costs

Construction cost for the entire alternative would be: $ 3,817,000.

Yearly maintenance cost would be: $ 41,860.

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the expanded UPRR culvert would be similar to existing culverts. The culvert would be designed to have adequate slope for sediment passage.

Operation and maintenance of the Saratoga-Sunnyvale additional tunnel would be similar to the existing single underground tunnel. Although the Saratoga-Sunnyvale Road tunnel would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

Conclusion

Construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project. The estimated capital cost of this alternative would be within the acceptable limit for further consideration and review as a feasible alternative. ***Therefore, this alternative will be carried forward into the feasibility analysis.***

Alternative E

E1 Construct Levee/Floodwall at Calabazas Park

E3 Construct Levee/Floodwall Downstream of Footbridge

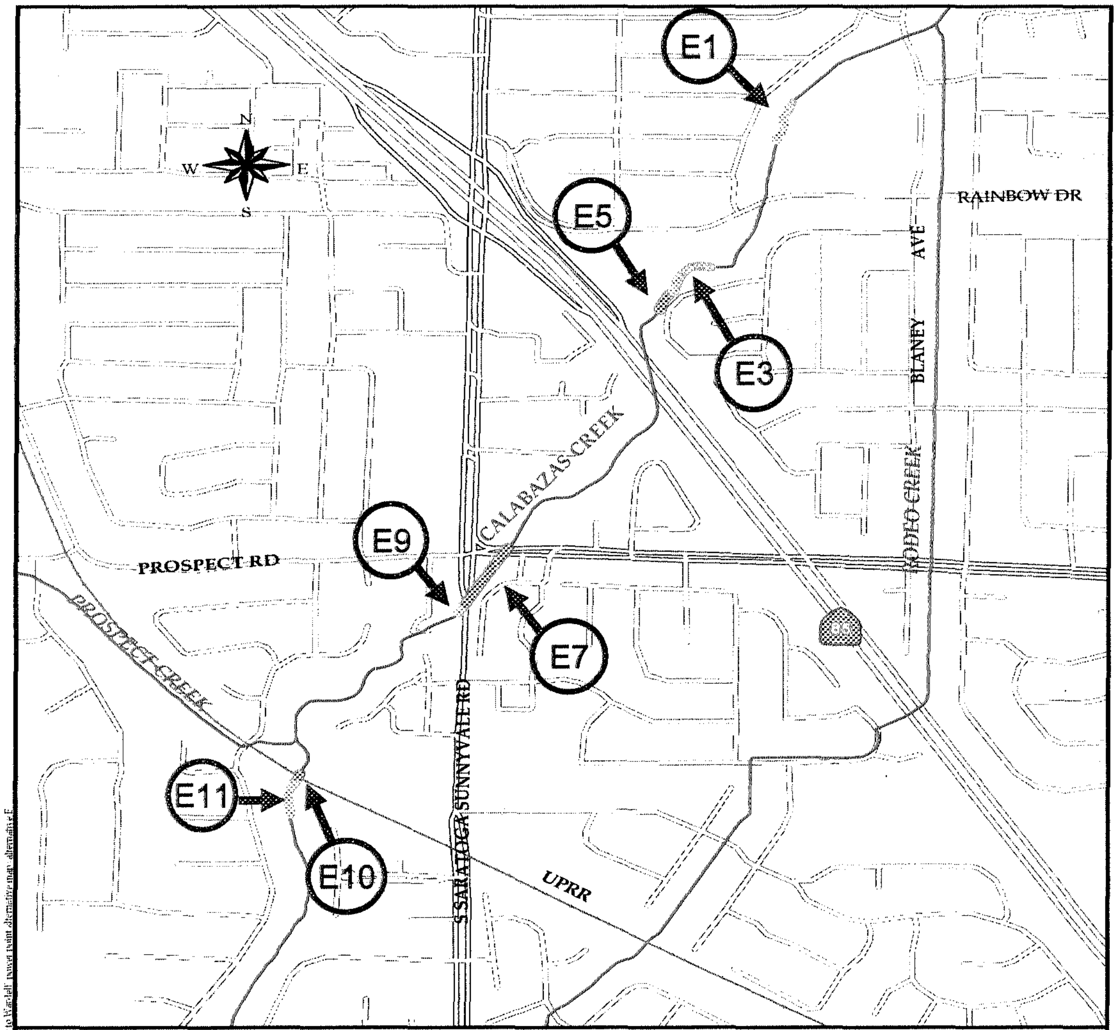
E5 Relocate Footbridge

E7 Construct Additional Tunnel Along Saratoga-Sunnyvale Road Tunnel

E9 Construct Levee/Floodwall Upstream of Saratoga-Sunnyvale Road Tunnel

E10 Replace Union Pacific Railroad Culvert

E11 Construct Levee/Floodwall Upstream of Union Pacific Railroad



Calabazas Creek
Miller Ave. to Comer Dr.
Alternative E
Figure 2.5

Conceptual Flood Protection Alternative F

Alternative Description

This alternative combines channel widening, levees or floodwalls, relocation of an existing footbridge, and culvert replacement elements to increase the capacity of all project reaches to the design flows (see Figure 2). Conceptual Flood Protection Alternative F is composed of the following elements "Es":

Provisions for Alternative F are listed below in order from the most downstream point in this alternative to the most upstream point. See Attachment A for complete details.

***E2: Channel Widening at Calabazas Park** (approx. STA 483+80 to STA 489+73)*
Between Blaney Avenue and Rainbow Drive, this 600 foot channel section through Calabazas Park would be enlarged.

***E3: Levee/Floodwall d/s of Footbridge** (approx. STA 498+36 to STA 502+42)*
Beginning at a point 400 feet downstream of the footbridge (relocated) and ending at the footbridge, build a levee / floodwall atop the left bank (looking u/s).

***E5: Footbridge Relocation** (approx. STA 502+35 to STA 502+42)*
The footbridge located downstream of HWY 85 would be removed and relocated approximately 100 feet upstream of the existing location. This footbridge provides access to the Cupertino Creekside Apartment pool which is located on the east side of the creek.

***E8: Saratoga-Sunnyvale Tunnel Replacement** (approx. STA 525+11 to STA 531+94)*
The existing 9-foot by 14-foot underground concrete tunnel with a length of approximately 650-feet from Prospect Road to Saratoga-Sunnyvale Road would be demolished and replaced by a new 9-foot by 24-foot underground concrete tunnel.

***E9: Levee/Floodwall u/s Saratoga-Sunnyvale** (approx. STA 531+94 to STA 535+89)*
Build a levee / floodwall on the right bank upstream of the Saratoga-Sunnyvale Road tunnel for approx. 400-feet.

***E10: UPRR Culvert Replacement** (approx. STA 548+28 to STA 548+63)*
The existing 6-foot by 13-foot concrete box culvert would be demolished and replaced by a new 6-foot by 23-foot concrete box culvert.

***E11: Levee/Floodwall u/s UPRR** (approx. STA 549+05 to STA 549+80)*
Build a levee / floodwall on both banks for a distance of 150 feet upstream of UPRR.

Conceptual Alternative Screening Analysis

This alternative would satisfy the project objectives in the following ways:

- Protect 2,483 parcels from a one-percent flood.
- Protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.

- Protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- Protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- Protect business developments, as well as keep the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would be protected from a one-percent flood by fully containing flows within the creek.
- Provide opportunities for a continuous maintenance corridor along the creeks by including space for suitable maintenance access.
- Protect the watershed's current environmental resources, accommodates environmental enhancements, and will not preclude new recreational opportunities.

Construction Schedule

Expansion of the UPRR culvert and Saratoga-Sunnyvale underground tunnel would both take 1 to 2 construction seasons depending on the difficulties relocating existing utilities located along the railroad and beneath the local roadways. The channel widening at Calabazas Park, the levee/floodwall construction, and the relocation of the footbridge could all be completed in 1 construction season.

Temporary Local Neighborhood Impacts

- ***Public Services and Utilities:***
  Construction activities could interrupt or disturb public services and utilities. Existing underground utilities are located beneath roadways in the construction area. Implementation may require relocation and/or temporary disruption of some existing utilities.
- ***Traffic:***
  Construction activities (such as equipment operation, staging, materials transport, spoils disposal, and similar or related activities) and construction-related traffic would temporarily affect traffic on streets in and adjacent to construction areas during the construction period. Additionally, construction of new underground culverts could limit use of affected roadways, sidewalks, and bike lanes during construction. In addition, traffic using bridges in the project area could be affected by construction activities.

Technical Feasibility

All project elements are technically feasible with current construction techniques.

Land Ownership/Access

It is expected that the new tunnel under Saratoga-Sunnyvale Road would be constructed within SCVWD easement. All work on the Union Pacific Rail Road (UPRR) culvert would occur within the state of California (Caltrans) right-of-way and SCVWD easements. No land acquisition would be necessary from property owners for other works; they would occur within the existing District easements or fee properties.

Costs

Construction cost for the entire alternative would be: $ 4,748,000.

Yearly maintenance cost would be: $ 41,860.

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance activities for the expanded UPRR culvert and Saratoga-Sunnyvale Road tunnel would be similar to those activities at other existing culverts and tunnels. The new UPRR culvert would be designed to have adequate slope for sediment passage.

Although the Saratoga-Sunnyvale Road tunnel would be designed with adequate slope to move debris, the inlets would still require the current scheduled routine cleaning to remove leaves and other debris during the flow season.

Conclusion

Construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project. The estimated capital cost of this alternative would be within the acceptable limit for further consideration and review as a feasible alternative. ***Therefore, this alternative will be carried forward into the feasibility analysis.***

Alternative F

E2 **Widen Channel at Calabazas Park**

E3 **Construct Levee/Floodwall Downstream of Footbridge**

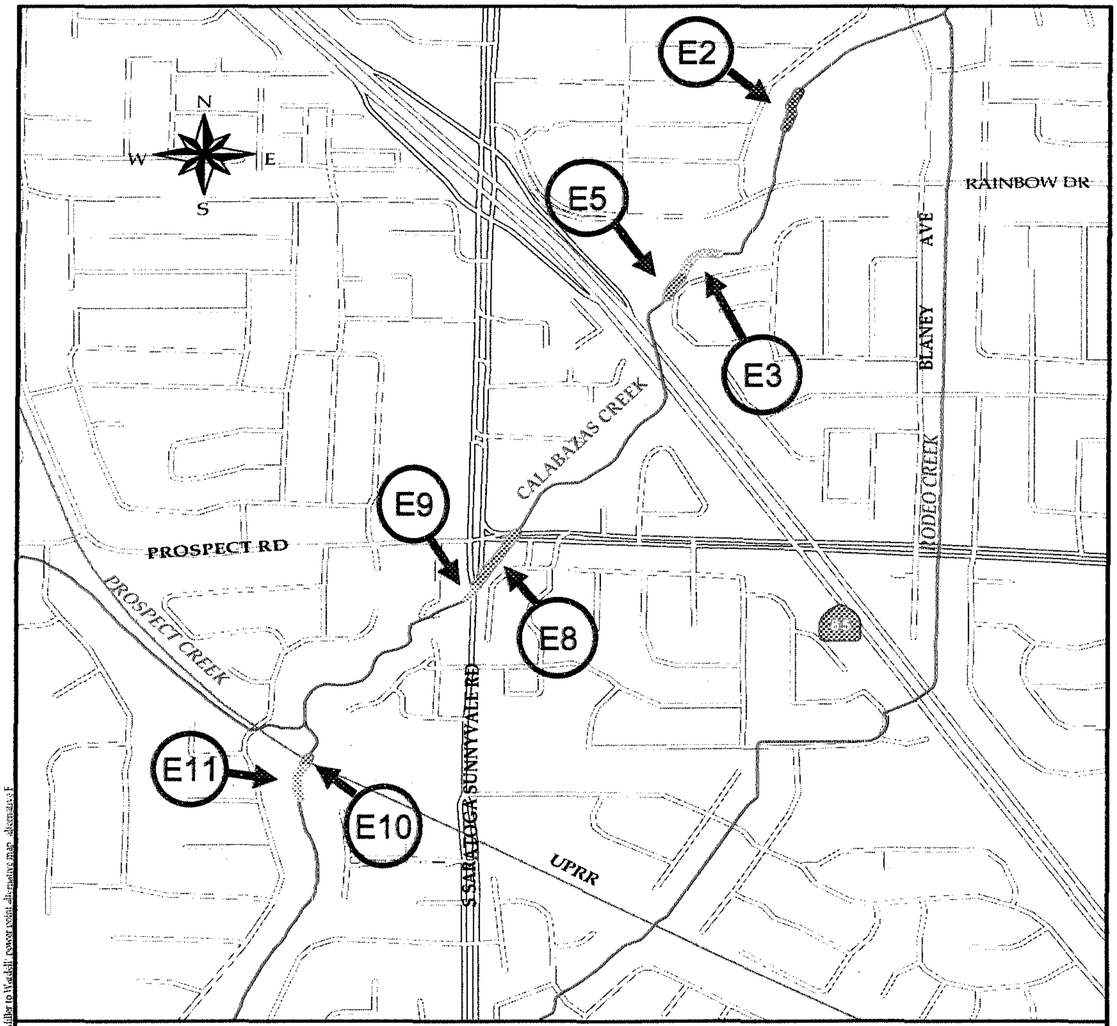
E5 **Relocate Footbridge**

E8 **Replace Saratoga-Sunnyvale Road Tunnel**

E9 **Construct Levee/Floodwall Upstream of Saratoga-Sunnyvale Road Tunnel**

E10 **Replace Union Pacific Railroad Culvert**

E11 **Construct Levee/Floodwall Upstream of Union Pacific Railroad**



Calabazas Creek
Miller Ave. to Comer Dr.
Alternative F
Figure 2.6

Maria - O:\Calabazas Creek\Miller to Waddell\ power point alternative map_alternative F

Conceptual Flood Protection Alternative G

Alternative Description

This alternative uses flood proofing elements to protect the properties in the floodplain from damages during flood events (see Figure 2.7). Conceptual Flood Protection Alternative G is composed of the following element "E":

Non-Structural (Flood proofing)

The 2,483 parcels in the one-percent floodplain would be protected by either of two means: structural elevation or flood shielding. Structural elevation would be achieved by raising parcel improvements (actual house structures) above the flood elevation and placing them on new foundations. Flood shielding would protect parcels by surrounding the perimeters of properties with water proof shielding to an elevation higher than the flood elevation.

Conceptual Alternative Screening Analysis

This alternative would satisfy the proposed project objectives in the following way:

- Protect 2,483 parcels from a one-percent flood by preventing damaging water from reaching or destroying property.

This alternative would not satisfy the proposed project objectives in the following ways:

- It *would not* protect the Public Library and YMCA next to Calabazas Park from flooding in the Park area in the City of San Jose.
- It *would not* protect residential development along Calabazas Creek Circle from flooding caused by the footbridge channel constriction between Rainbow Drive and HWY 85.
- It *would not* protect residences upstream of the UPRR Culvert from flood damage caused by the UPRR culvert operating as a bottleneck in high flows.
- It *would not* protect business developments, as well as not prevent the Saratoga-Sunnyvale underground tunnel from submerging with pressure flow. The intersection of Prospect Road and Saratoga-Sunnyvale Road would continue to flood during the 1% storm event.
- It *would not* minimize long-term maintenance costs.
- It *would not* consider opportunities for a continuous maintenance corridor along the creeks.
- It *would not* protect the watershed's current environmental resources and would not identify opportunities for environmental enhancements.

Construction Schedule

The flood proofing could occur on individual houses over many years. Much of this work has the advantage of being located outside of the channel where permit issues don't limit construction work to one (dry) season.

Technical Feasibility

This project element is technically feasible with current construction techniques.

Land Ownership / Access

Construction access easements would have to be worked out with individual owners. No permanent easements would be acquired.

Costs

Construction costs would be $ 19,484,375

Maintenance costs would be $ 41,860

Preliminary Environmental Review

See Appendix D

Operation and Maintenance

Current operations and maintenance practices would continue in the creek. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Maintenance of the flood proofing elements would be up to the individual property owners.

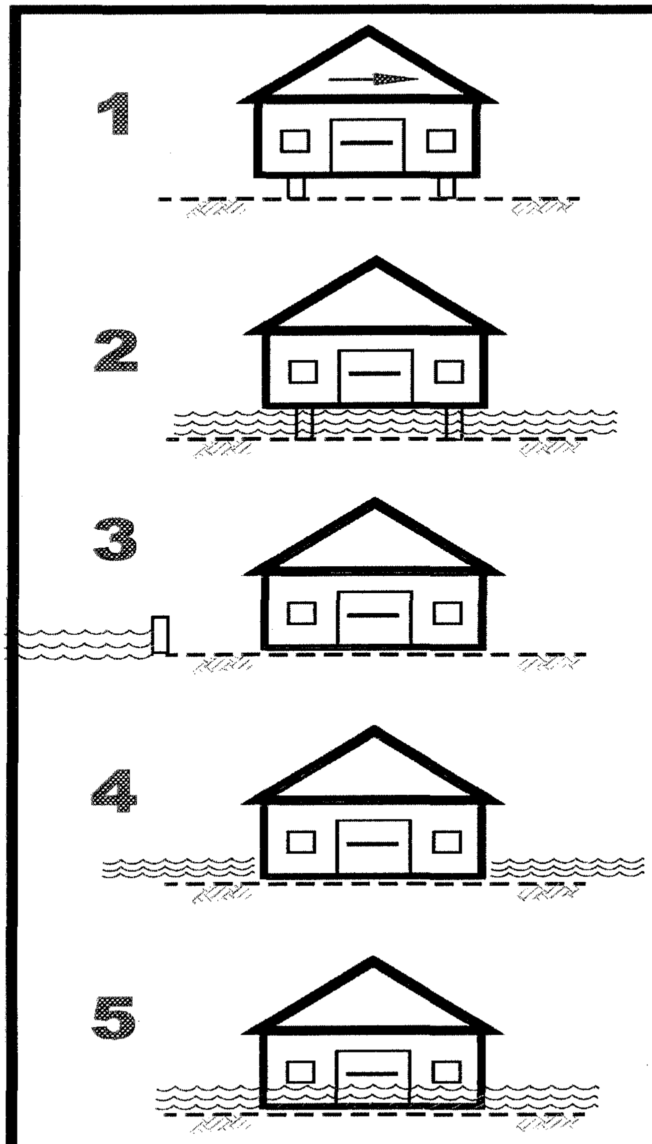
Conclusion

Design, construction, operation, and maintenance of this alternative is technically feasible, and there is sufficient availability of land for the proposed alternative to move into the feasible alternative stage of the project.

However, the estimated capital cost of this alternative exceeds the acceptable project limit, and because it also fails to satisfy the project objectives by only addressing the effect and not the cause of the problem, it has been eliminated from further consideration and will not be carried forward into the feasibility analysis. Although the estimated capital cost of the limited construction option is within the acceptable limit for further consideration and review as a feasible alternative, it too does not satisfy the project objectives. ***Therefore, this alternative will not be carried forward into the feasibility analysis.***

Alternative G Floodproofing

1. Relocate building
2. Elevate building
3. Build floodwalls around houses
4. Dry floodproofing
5. Wet floodproofing



Relocation:
Moving a building to high ground, above flood level

Elevation:
Raising a building so that flood water will go under it

Floodwalls:
Building a wall to keep flood water from reaching a building

Dry floodproofing:
Making the walls of the building and the openings watertight

Wet floodproofing:
Altering a building to minimize damage when flood waters enter

Figure 2.7 Examples of flood proofing
NOT TO SCALE

3. Erosion Control Project Elements

This chapter outlines the project elements for the erosion sites in the Calabazas Creek planning Study. Discussed in this chapter are the: goal of the erosion control project, erosion site selection criteria, bank erosion repair methods available, channel maintenance activities, construction impacts incurred, and mitigation possibilities for impacts incurred.

Goal of the Erosion Control Project

The goal of the program is to repair the current erosion problems along Calabazas Creek, thereby reestablishing a stable creek after the completion of the capital improvement project. An emphasis is placed on integration of new maintenance and erosion control measures utilizing primarily organic materials to maintain the stability as well as natural ecology of creek.

Erosion Site Selection

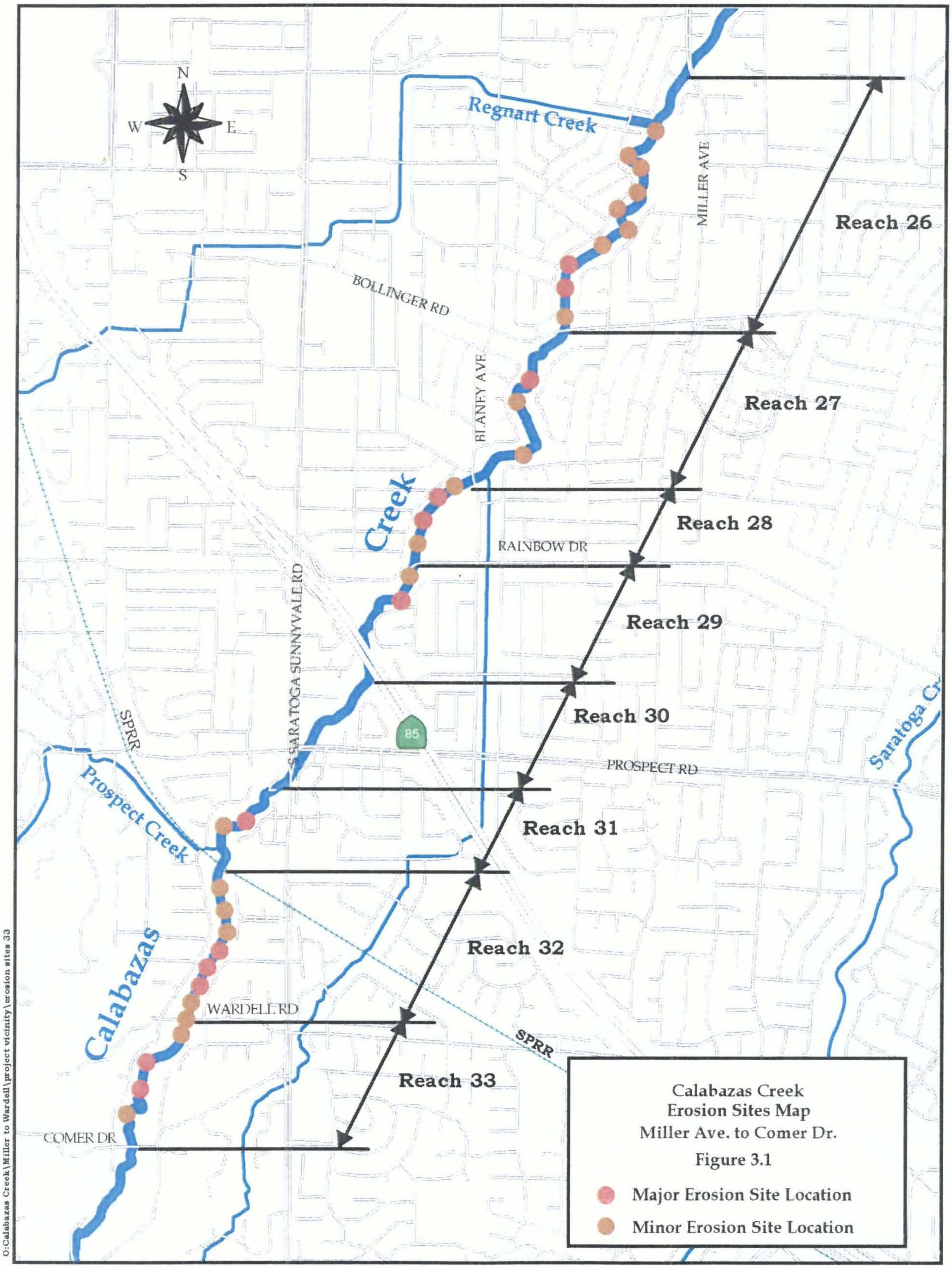
Soil erosion occurs both on the channel banks and bottom. As bank erosion occurs, vegetation is lost, soil is lost, property improvements may be threatened, and channel capacity may be compromised. As the creek bottom erodes, the channel becomes deeper and more incised, resulting in less stable banks with greater potential for bank erosion and failure. Increased soil erosion on the channel banks and bottom increase suspended sediment in the creek degrading aquatic habitat.

During the course of the study, District employees surveyed Calabazas Creek for developing erosion problems. The sites located were broken up into three categories:

- Major
- Minor
- Noted Only

The sites identified as "major" were actively eroding and threatening either structures or large top-of-bank trees. The sites identified as "minor" were not actively or severely eroding, but they have the potential to become "major" if they continue to erode. The District will keep monitoring the existing unstable bank slopes, unprotected tree roots, vegetation, and sediment. The sites identified as "noted only" are sites that have the potential to become erosion problems in the future.

Thirty-five erosion sites were identified during the survey on May 2005. Of those identified, fourteen were classified as "major," seventeen were classified as "minor," and four were classified as "noted only." Two of the “major” erosion sites were repaired in June 2005 by the Maintenance Department due to the critical nature of the erosion. Therefore, there are twelve remaining erosion sites still classified as “major” (See Figure 3.1).



Calabazas Creek
Erosion Sites Map
Miller Ave. to Comer Dr.
Figure 3.1

● Major Erosion Site Location

● Minor Erosion Site Location

O:Calabazas Creek\Miller to Wardell\project vicinity\erosion sites 33

The twelve remaining "major" erosion sites were evaluated for repair and added to the proposed capital improvement project. These sites are summarized in Table 3.1, and shown in the photographs of figure 3.2. The seventeen "minor" and four "noted only" erosion sites will be monitored by maintenance personnel for any evidence of further erosion in the future. These sites are summarized in Table 3.2, and shown in the photographs of figure 3.3. Corrective action will follow specified maintenance program guidelines.

Erosion Site Repair Criteria and Methods

The objective when selecting an erosion protection method is to meet engineering requirements and provide the greatest biological enhancement with the least amount of impact. The engineering requirements involve the physical ability of the material to provide reliable structural support within the site constraints. This includes the ability of the material to provide lateral support to the bank and sustained protection against erosive velocities. Biological enhancement considers the ability of the method to provide opportunity for natural re-vegetation. Once erosion has occurred, the site constraints determined, cause of erosion determined, and ecological setting evaluated, the erosion protection method and material is selected.

The methods and materials available for erosion repair listed below (detailed descriptions given in the maintenance section) were evaluated for consideration for the repair of the 12 erosion sites in the order presented.

I. Live Construction (traditional use of grass or live plant cuttings)

    A. Cuttings
    B. Transplants
    C. Live Staking
    D. Direct Seeding

II. Mixed Construction (methods using organic combined with inert materials)

    A. Soil Bioengineering
        1. Contour Wattling
        2. Brush Layering
        3. Bank Surface Matting

    B. Biotechnical Slope Protection
        1. Boulder toe covered with vegetation
        2. Root Wad with Footer
        3. Soil Cellular Confinement System (GEOCELL)
        4. Rock Riprap
        5. Live Log Crib Wall

6. Combination with live construction

III. Armoring (Inert) Construction (using only inert structural materials)

  A. Sacked Concrete Slope Protection (SCSP)
  B. Gunite

Where it was observed that the channel bottom was actively degrading, vortex rock weirs will be installed downstream of the channel bank erosion to prevent any further degradation. Bank instability and erosion may, in some cases, be directly correlated to increased bank height due to channel bottom degradation.

Vortex rock weirs will be constructed with large 4 to 5-foot diameter rock boulders and will be "keyed" into the bank to eliminate erosion. Smaller rock riprap will also be placed at the downstream side of the weir, where necessary, to form a plunge pool for aquatic habitat and to protect the weir. The size of the rock riprap will be designed so that the maximum expected flow velocity will not be able to move the rock.

Vortex rock weirs will be limited to use where there is less than approximately 2 feet vertical change in grade. If more height is needed, multiple weirs or step pools will be installed.

Erosion Site Repair Impacts and Mitigation

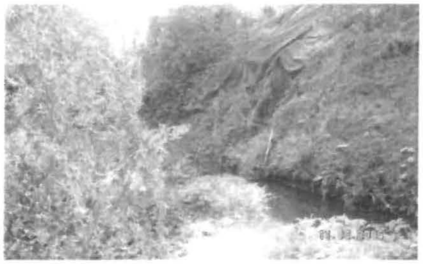
As previously mentioned, vegetation impacts will be avoided whenever possible; however, if vegetation must be removed for an erosion repair to be functional, the impacts will be mitigated in accordance with generally accepted practices. Projected impacts will be disclosed in the Feasibility Study Report to follow.

Table 3.1 - Proposed Erosion Repair Sites
Calabazas Creek Planning Study

Creek Station	Reach	Description	Recommendation
438+75 ±	26	Looking upstream, 23' high, 60' wide severe erosion on the west slope and storm drain outfall (covered) has lack of support.	Boulder Toe Slope Protection
440+40 ±	26	The steepness of bare banks is evident in this photo (west bank).	Rock Protection/Crib Wall
456+85 ±	27	Looking upstream, 10' high, 60' wide moderate erosion is evident on east bank. Tree roots are exposed.	Rock Riprap
481+50 ±	28	Looking upstream, 8' high, 60' wide severe erosion on the west bank. Tree roots are exposed.	Rock Riprap
484+37 ±	28	Looking upstream, 10' high, greater than 150' wide east bank is eroded and the tree roots are exposed.	Live Log Slope Protection
498+26 ±	29	Looking upstream, 6' high, 90' wide severe erosion on the east slope and tree roots are hanging out of the top of the bank.	Rock Riprap
537+00 ±	31	Looking downstream, the 8' high, 70' wide steep and bare banks are eroded and covered with vegetation.	Boulder Toe Slope Protection
559+30 ±	32	Looking upstream, 10' high, 100' wide severe erosion occurs on the west bank and concrete pavement is broken, resulting in lack of soil support.	Boulder Toe Slope Protection
563+04 ±	32	Looking downstream, 10' high, 70' wide severe erosion is evident on the east bank. Temporary chain link fence is installed to avoid debris and brush sliding	Rock Protection
565+98 ±	32	Looking downstream, 6' high, 25' wide severe erosion is seen on the east bank and fence post is exposed.	Live Log Slope Protection
583+02 ±	33	Looking upstream, 17' high, 80' wide severe erosion occurs on the steep and bare west bank adjacent to fence line.	Crib Wall/Sacked Concrete Slope Protection
587+84 ±	33	16' high, 100' wide severe erosion occurs on the west bank. Bare material and tree roots are hanging out of the top of the bank.	Sacked Concrete Slope Protection

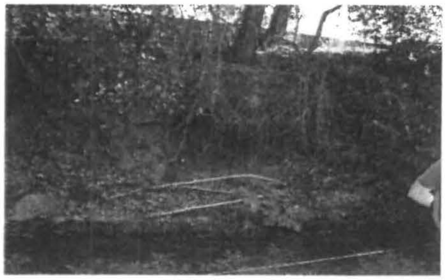
RECENT CALABAZAS PHOTOGRAPHS

SELECTED MAJOR EROSION SITES



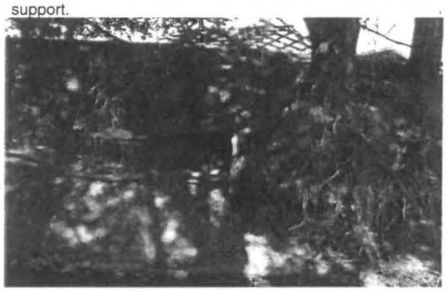
(STA 438+75) ±

Rch 26: Looking upstream, there is severe erosion on the west slope and the storm drain outfall (covered) has lack of support.



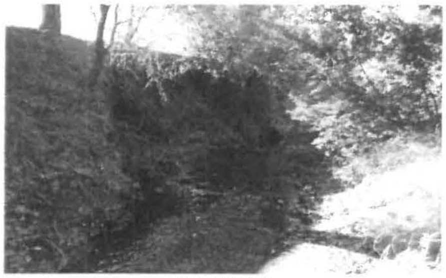
(STA 456+85) ±

Rch 27: Looking upstream, moderate erosion is evident on the east bank. Tree roots are exposed.



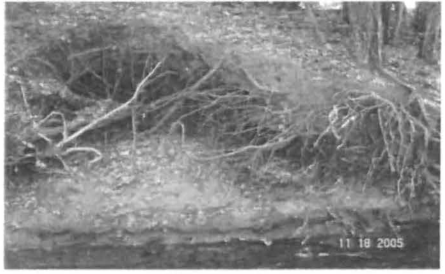
(STA 481+50) ±

Rch 28: Looking upstream, there is severe erosion on the west bank and tree roots are exposed.



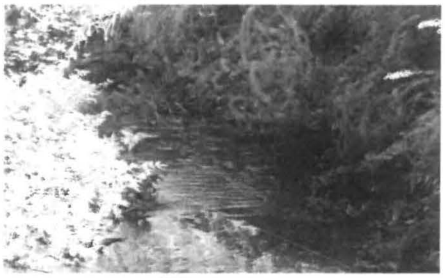
(STA 484+37) ±

Rch 28: looking upstream, the east bank is eroded and tree roots are exposed.



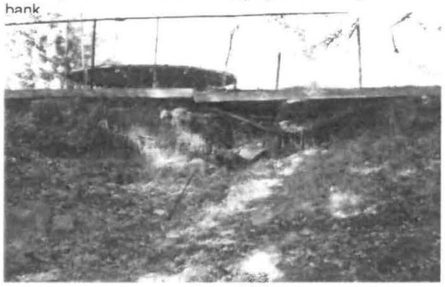
(STA 498+26) ±

Rch 29: Looking upstream, there is severe erosion on the east slope and tree roots are hanging out of the top of the bank.



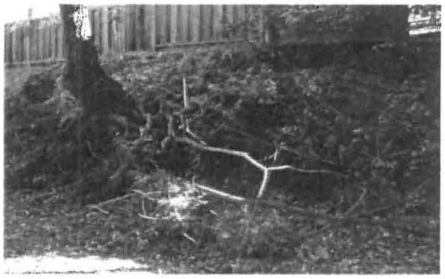
(STA 537+00) ±

Rch 31: Looking downstream, the steep, bare banks are eroded and covered with vegetation.



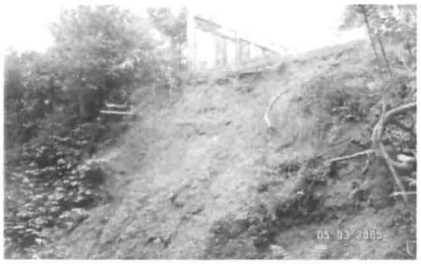
(STA 559+30) ±

Rch 32: Looking upstream, severe erosion has occurred on the west bank and concrete pavement has broken from lack of soil support.



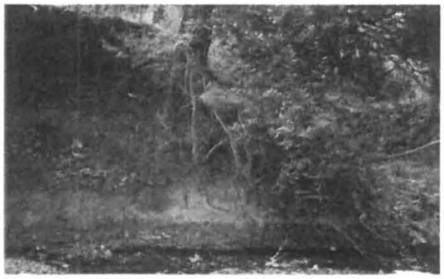
(STA 565+98) ±

Rch 32: Looking downstream, severe erosion is seen on the east bank and fence posts are exposed.



(STA 583+02) ±

Rch 33: Looking upstream, severe erosion has occurred on the steep and bare west bank adjacent to the fence line.



(STA 587+84) ±

Rch 33: Severe erosion has occurred on the west, leaving it bare. Tree roots are hanging out of the top of the bank.

RECENT CALABAZAS PHOTOGRAPHS

SELECTED MAJOR EROSION SITES

(STA 563+04) ±

Rch 32: Looking downstream, severe erosion is evident on the east bank. Temporary chain link fence is installed to prevent the debris and brush from sliding.

(STA 440+40) ±

Rch 26: The steepness of bare banks is evident in this photo (west bank).

Table 3.2 - Proposed Erosion Monitoring Sites
Calabazas Creek Planning Study

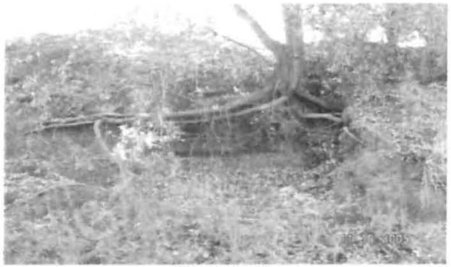
Creek Station	Reach	Description	Recommendation
411+60 ±	26	Looking upstream, moderate erosion is evident on east bank. Tree roots are exposed.	Monitoring
415+48 ±	26	Looking upstream, scour occurs under sacked concrete slope protection on west toe.	Monitoring
424+70 ±	26	Looking upstream, spot erosion occurs along Calabazas Creek adjacent to Calabazas Park.	Monitoring
426+05 ±	26	Looking downstream, erosion occurs on the east bank slope with bare soil material.	Monitoring
428+65 ±	26	Looking upstream, severe erosion on the east bank with bare soil material.	Monitoring
429+81 ±	26	Looking upstream, scour occurs behind the sacked concrete slope protection on east bank.	Monitoring
430+78 ±	26	Looking upstream on the east bank, significant erosion is evident and tree roots are exposed on the top.	Monitoring
432+41 ±	26	The east bank is eroded and tree roots are exposed.	Monitoring
457+67 ±	27	Looking up, severe erosion is seen on west bank.	Monitoring
474+70 ±	27	Looking upstream, moderate erosion occurs on east slope.	Monitoring
480+98 ±	28	Looking downstream, erosion occurs on the east bank slope with bare soil material.	Monitoring
488+71 ±	28	Looking upstream, erosion occurs on west bank and tree roots are exposed on the top.	Monitoring
497+65 ±	29	Looking upstream, severe erosion is seen on east bank.	Monitoring

Table 3.2 - Proposed Erosion Monitoring Sites
Calabazas Creek Planning Study (continued)

Creek Station	Reach	Description	Recommendation
538+32 ±	31	The west slope is eroded and covered with vegetation.	Monitoring
542+30 ±	31	Looking downstream, moderate erosion on the east slope.	Monitoring
550+97 ±	32	Looking upstream, the west bank slope is eroded.	Monitoring
553+03 ±	32	Looking upstream, erosion occurs on the steeper east bank slope.	Monitoring
554+43 ±	32	Looking upstream, the east bank is eroded and tree roots are exposed.	Monitoring
556+70 ±	32	Looking downstream, scour behind the sacked concrete slope protection on the east slope.	Monitoring
578+58 ±	32	Looking upstream, erosion is seen on the west slope.	Monitoring
589+75 ±	33	Looking upstream, the fallen tree is lying across the stream bed and the bank toe is eroded.	Monitoring

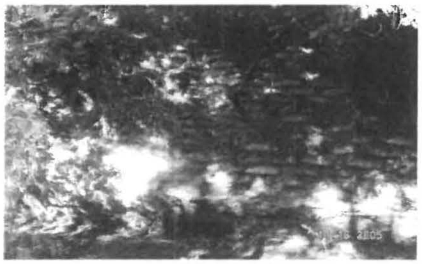
RECENT CALABAZAS PHOTOGRAPHS

EROSION MONITORING SITES



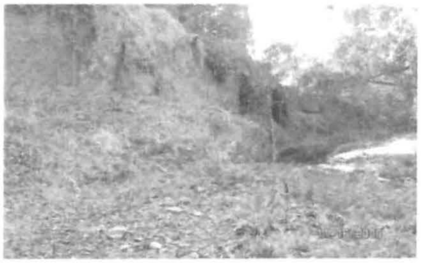
(STA 411+60) ±

Rch 26: Looking upstream, moderate erosion is evident on east bank. Tree roots are exposed.



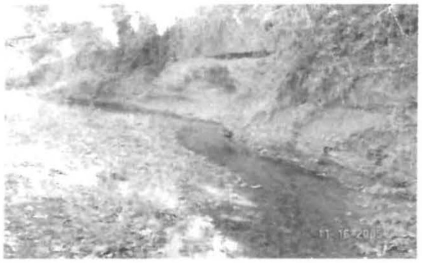
(STA 415+48) ±

Rch 26: Looking upstream, scour occurs under sacked concrete slope protection on west toe.



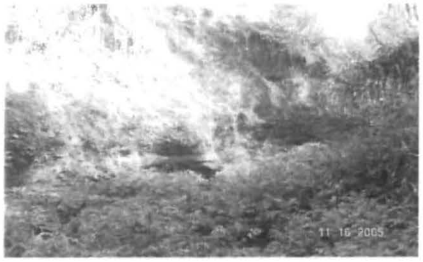
(STA 424+70) ±

Rch 26: Looking upstream, spot erosion occurs along Calabazas Creek adjacent to Calabazas Park.



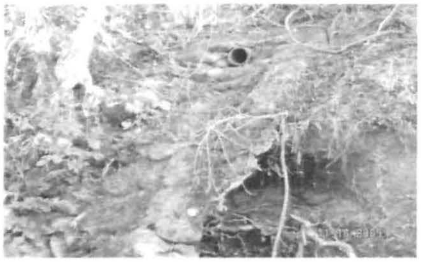
(STA 426+05) ±

Rch 26: Looking downstream, erosion occurs on the east bank slope with bare soil material.



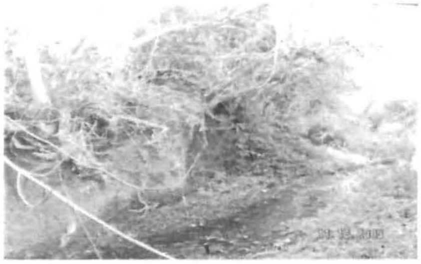
(STA 428+65) ±

Rch 26: Looking upstream, severe erosion on the east bank with bare soil material.



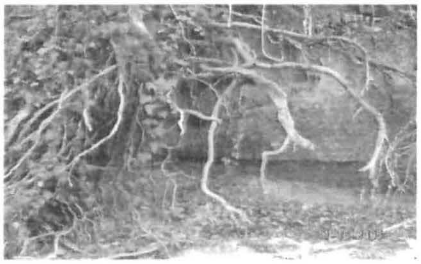
(STA 429+81) ±

Rch 26: Looking upstream, scour occurs behind the sacked concrete slope protection on east bank



(STA 430+78) ±

Rch 26: Looking upstream on the east bank, significant erosion is evident and tree roots are exposed on the top.



(STA 432+41) ±

Rch 26: The east bank is eroded and tree roots are exposed.

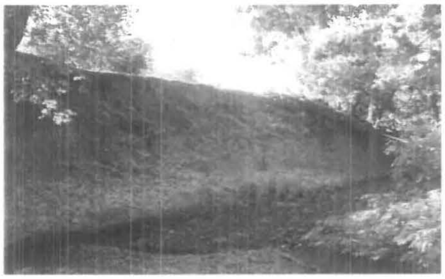
(STA 457+67) ±

Rch 27: Looking up, severe erosion is seen on west bank.

(STA 474+70) ±

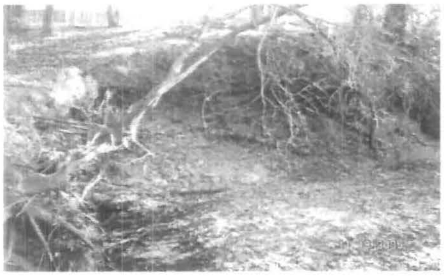
Rch 27: Looking upstream, moderate erosion occurs on east slope.

EROSION MONITORING SITES



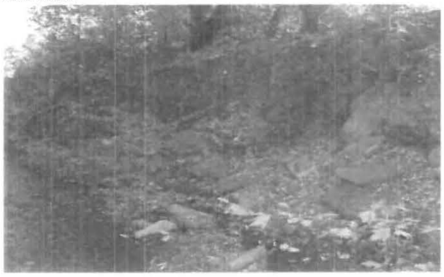
(STA 480+98) ±

Rch 28: Looking downstream, erosion occurs on the east bank slope with bare soil material.



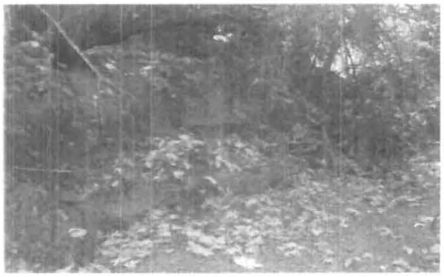
(STA 497+65) ±

Rch 29: Looking upstream, severe erosion is seen on east bank.



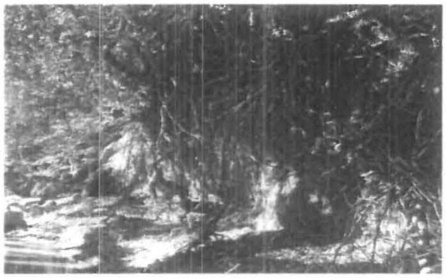
(STA 542+30) ±

Rch 31: Looking downstream, moderate erosion on the east slope.



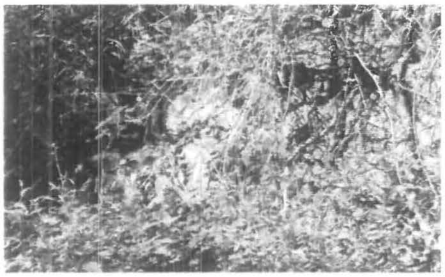
(STA 553+03) ±

Rch 32: Looking upstream, erosion occurs on the steeper east bank slope.



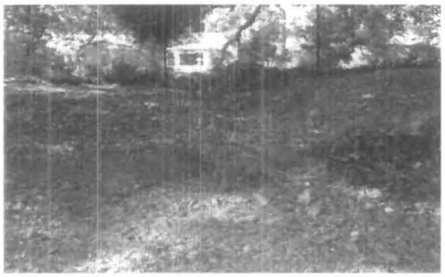
(STA 488+71) ±

Rch 28: Looking upstream, erosion occurs on west bank and tree roots are exposed on the top.



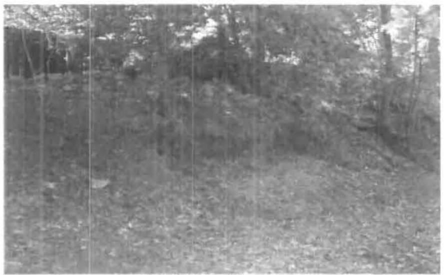
(STA 538+32) ±

Rch 31: The west slope is eroded and covered with vegetation.



(STA 550+97) ±

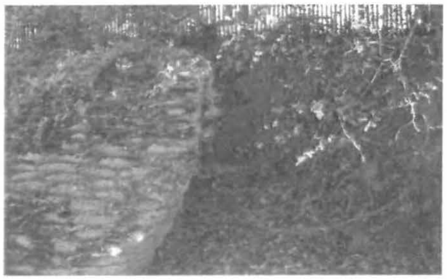
Rch 32: Looking upstream, the west bank slope is eroded.



(STA 554+43) ±

Rch 32: Looking upstream, the east bank is eroded and tree roots are exposed.

EROSION MONITORING SITES

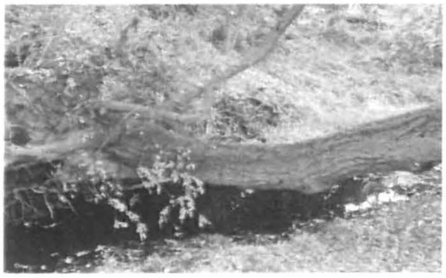


(STA 556+70) ±

Rch 32: Looking downstream, scour behind the sacked concrete slope protection on the east slope.

(STA 578+58) ±

Rch 32: Looking upstream, erosion is seen on the west slope.



(STA 589+75) ±

Rch 33: Looking upstream, the fallen tree is lying across the stream bed and the bank toe is eroded.

Maintenance Program

A maintenance program is necessary to ensure continued functionality, public safety, and effective stabilization of Calabazas Creek from Miller Avenue to the upstream study limit of the Comer Debris Basin property.

This section outlines the proposed maintenance activities of the District for Calabazas Creek. After approval of this document, these guidelines will add to the existing maintenance program. This maintenance program will be performed in accordance with the governing regulatory permits (Memorandum of Understanding [MOU] and Streambed Alteration Permits with the California Department of Fish and Game and Section 404 of the Clean Water Act administered by the U.S. Army Corps of Engineers).

Maintenance activities for proposed modifications on Calabazas Creek will begin after completion of construction and will be performed under the Routine Maintenance Activities in the Improved Channel MOU. Maintenance activities have been, and will only be, performed on areas where the District has a right of way. Maintenance standards for removal of sediment and vegetation on Calabazas Creek are included in Table 3.4.

Residents along Calabazas Creek that are responsible for creek maintenance on their property should use this program as a guide. Permits are required by District Ordinance 83-2 for any work done within the District's jurisdiction.

Maintenance Activities

The goals of the maintenance program include: restoring the channel to design conditions, repairing channel facilities as necessary, and eliminating hazardous conditions. The channel will be restored to design conditions by controlling woody growth in the creek channel and by removing accumulated debris and sediment. Channel protection and conveyance structures (bridges, culverts, rock riprap, live log slope protection, crib wall and vortex rock weirs, etc.) will be repaired as necessary. Hazardous conditions will be eliminated by repairing and protecting eroding channel banks, protecting degrading channel bottom, and removing obstructions to flow such as fallen trees and debris. District personnel will perform annual inspections to determine needed maintenance on Calabazas Creek.

Severe erosion that causes hazardous steep banks, loss of vegetation, and exposure of bare soil is environmentally damaging. The District will utilize appropriate measures to protect eroding channel banks. The District will also install vortex rock weirs to stop excessive degradation of the channel bottom if required. As erosion repair measures are constructed, concrete rubble will be removed where appropriate.

Sediment in the channel will be allowed to accumulate to an acceptable maintenance limit. When this limit is exceeded, the accumulated sediment would be considered an obstruction to flow and the channel will be restored to design conditions. See Table3.4 for sediment limits.

Vegetation in the channel (toe of bank to toe of bank) will be allowed to grow to an acceptable maintenance limit. When this limit is exceeded, the vegetation would be considered an obstruction to flow and the channel will be restored to design conditions. Between maintenance cycles vegetation will provide habitat value and shading. See Table 3.4 for vegetation limits.

Obstructions to flow such as fallen trees and debris will be removed from the creek as needed.

Maintenance activities within the channel will be scheduled to minimize adverse impacts to fish and wildlife resources and their habitat. Periods of concern are March through June for nesting birds, and October through March for fish.

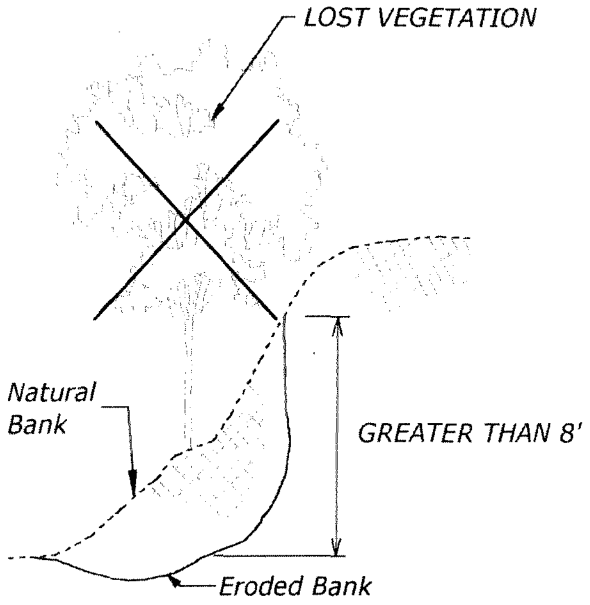
Erosion Control

Soil erosion is a natural process which occurs both on the channel banks and bottom. As bank erosion occurs, vegetation is lost, soil is lost, property improvements may be threatened, and channel capacity may be compromised. As the creek bottom erodes, the channel becomes deeper and more incised, resulting in less stable banks with greater potential for bank erosion and failure. Increased soil erosion on the channel banks and bottom increases suspended sediment in the creek degrading aquatic habitat.

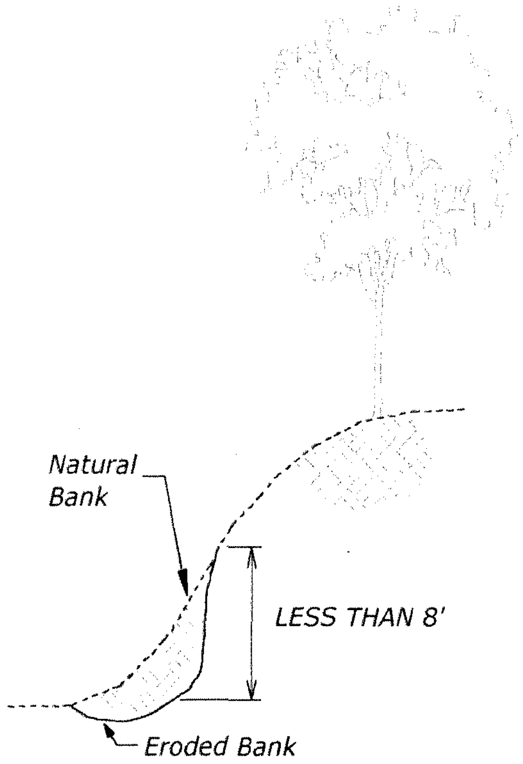
District employees monitor Calabazas Creek for developing erosion sites. Sites which are actively eroding will be subject to either (1) preventative slope protection, or (2) remedial slope protection. Preventative slope protection will be implemented and monitored at sites where banks are vertical or undercut up to 8 feet vertically (See Figure 3.4). Remedial slope protection will be implemented at sites where preventative maintenance was implemented and did not succeed, where preventative maintenance is highly unlikely to be sufficient to eliminate continued bank erosion, or where the bank is vertical or undercut greater than 8 feet vertically (See Figure 3.4).

Preventative Slope Protection

Preventative slope protection consists of protecting the toe of the channel bank, thereby stabilizing the zone of highest erosion potential and, if necessary, protecting the channel bottom to stabilize degradation. The bank toe will be stabilized by placing ½ -ton rock riprap to the height of ordinary high water (bankfull discharge) at that location with a minimum of 3 feet diameter of rock cut-off wall (See Figure 3.5). The rock may be in-filled with soil and covered with a biodegradable erosion mat where appropriate. The rock riprap will reduce the flow velocity at the interface with the native bank and will help promote natural



CONDITIONS
FOR REMEDIAL
SLOPE PROTECTION



CONDITIONS
FOR PREVENTATIVE
SLOPE PROTECTION

FIGURE 3.4
SLOPE PROTECTION CONDITIONS

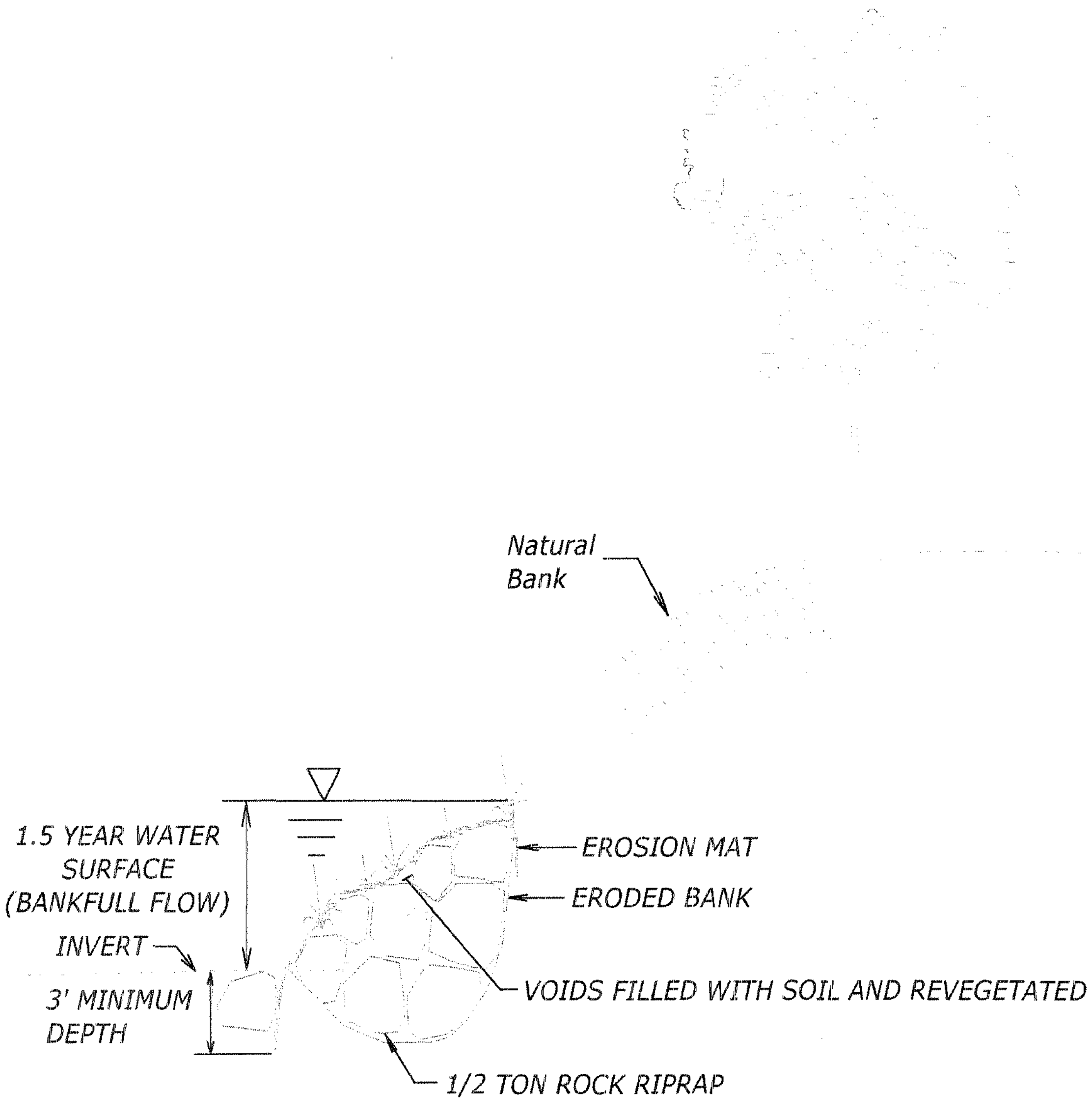

Natural Bank
1.5 YEAR WATER SURFACE (BANKFULL FLOW)
EROSION MAT
ERODED BANK
INVERT
VOIDS FILLED WITH SOIL AND REVEGETATED
3' MINIMUM DEPTH
1/2 TON ROCK RIPRAP

FIGURE 3.5
PREVENTATIVE EROSION SOLUTION

sedimentation around the rock riprap, encouraging naturally occurring re-vegetation. Rock groins (structures located at the bank toe perpendicular to flow) may also be placed to protect erodible bank by directing the flow toward the middle of the channel.

If it is observed that the channel bottom is actively degrading, vortex rock weirs will be installed downstream of the channel erosion to prevent any further degradation (Figures 3.6 and 3.7). All alluvial streams scour during flood events unless the bed is armored with large material. Bank instability and erosion may, in some cases, be directly correlated to increased bank height due to channel bottom degradation.

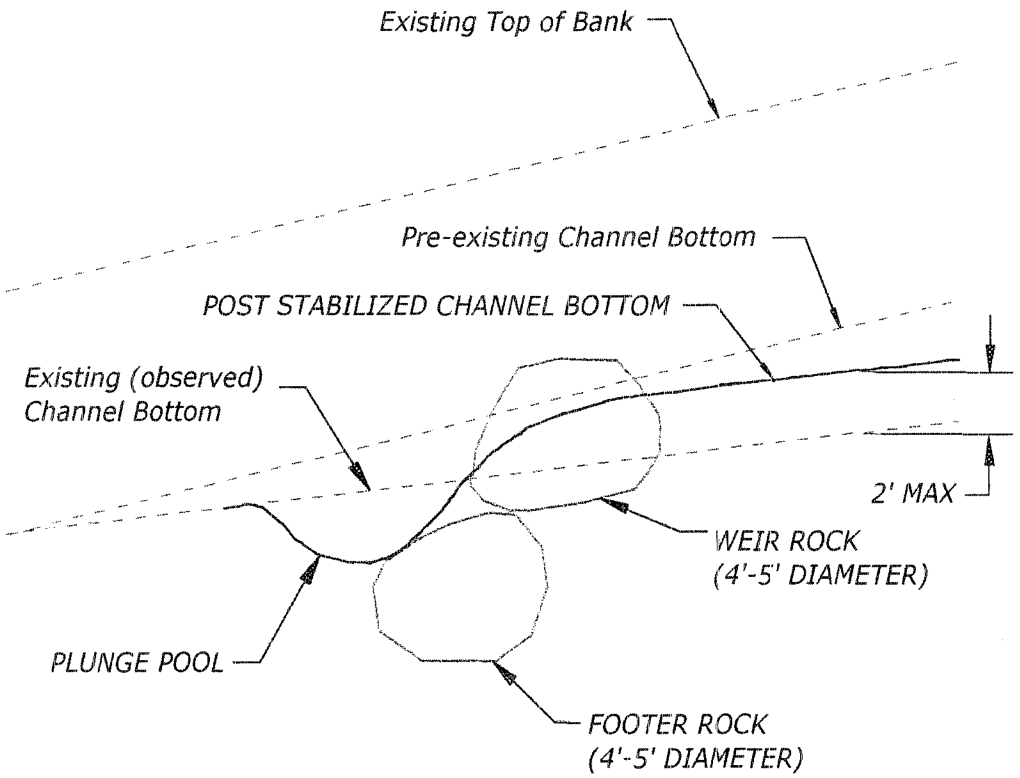
Vortex rock weirs will be constructed with large boulders 4 to 5 feet in diameter and will be "keyed" into the bank to minimize erosion. The weir is constructed in an arch-shape, with the closed end of the arch facing upstream. This forms a vortex that creates a downstream plunge pool for energy dissipation and aquatic habitat. A low flow channel will be incorporated into the weir. The sizes of the boulders are designed so that they will not be moved by any expected flow velocity. Vortex rock weirs will be limited to approximately two (2) feet in height above the channel bottom. If more height is needed to stabilize the channel, multiple weirs will be installed.

Remedial Slope Protection

Alternatives for remedial slope protection can be divided into three categories: live construction, mixed construction, and armoring (inert) construction. Live construction consists of the traditional methods using grasses or live plantings. Mixed construction consists of structural or mechanical methods using plant materials combined with armoring materials (rock riprap, root wads and boulders, cribwalls, etc.). Armoring construction consists of using only non-plant inert structural methods (sack concrete slope protection, gunite, etc.). A criterion for conditions under which each method is appropriate is outlined below and will be used in planning erosion protection projects to minimize adverse environmental impacts.

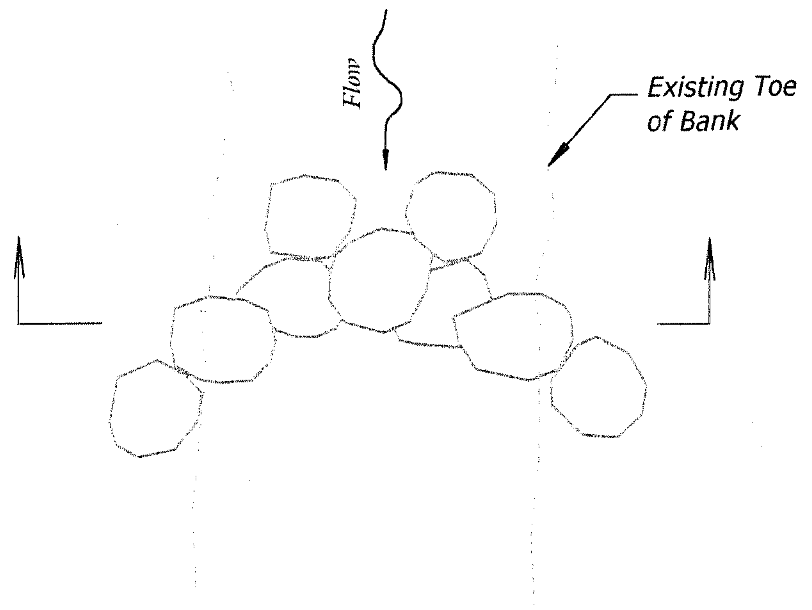
The objective when selecting an erosion protection method is to meet engineering requirements and provide the greatest biological enhancement with the least amount of negative impacts. Engineering requirements involve the physical ability of the material to provide reliable structural support within the site constraints. This includes the ability of the material to provide lateral support to the bank as well as sustained protection against erosive velocities. Biological enhancement considers the ability of the method to provide opportunity for natural re-vegetation. Once erosion on the earth channel has occurred, the site constraints determined, cause of erosion determined, and ecological setting evaluated, the erosion protection method and material will be considered and selected.

The methods and materials available for remedial slope protection will be evaluated for consideration in the order given below. A summary of the remedial slope protection methods is shown in Table 3.3 at the end of this section.

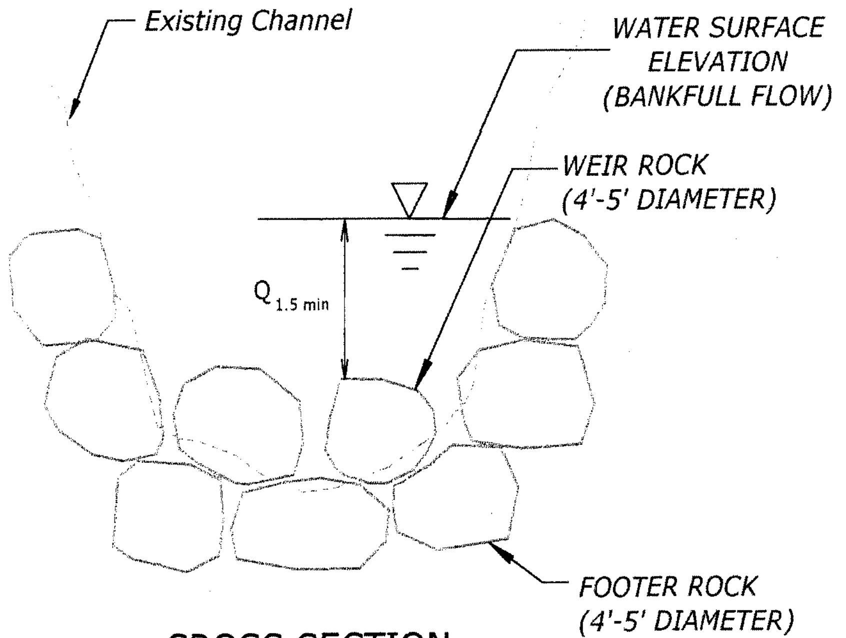

Existing Top of Bank
Pre-existing Channel Bottom
POST STABILIZED CHANNEL BOTTOM
Existing (observed) Channel Bottom
2' MAX
WEIR ROCK (4'-5' DIAMETER)
PLUNGE POOL
FOOTER ROCK (4'-5' DIAMETER)

PROFILE

FIGURE 3.6
VORTEX ROCK WEIR



PLAN VIEW


Existing Channel
WATER SURFACE ELEVATION (BANKFULL FLOW)
WEIR ROCK (4'-5' DIAMETER)
Q 1.5 min
FOOTER ROCK (4'-5' DIAMETER)

CROSS SECTION

FIGURE 3.7
VORTEX ROCK WEIR

Live Construction

Live construction consists of traditional methods of planting grasses and plants to control erosion. Vegetation planting methods typically used are cuttings, transplants, live staking, and direct seeding (including hydro-seeding). Plants are chosen to tolerate drought conditions. Biodegradable erosion control material is frequently used in combination with live construction to assist in plant establishment.

This type of erosion control provides good re-vegetation potential, but is only effective where bank slopes are 3:1 or flatter and for local channel velocities of 4 feet per second or less.

Mixed Construction

The District utilizes innovative technologies (where appropriate) to repair creek bank erosion. Mixed construction combines structural or mechanical methods using both plant materials and inert materials. Sub-categories of Mixed Construction are Soil Bioengineering and Biotechnical Slope Protection.

Soil Bioengineering

Soil Bioengineering refers to the use of plants and plant parts to control soil erosion. Live cuttings and plant parts are imbedded and arranged so that they act as soil reinforcements, hydraulic drains, or barriers to earth movement. Methods included in this subcategory include contour wattling, brush layering, and bank surface matting. While the root systems of these components can increase the "structural integrity" of a stream bank with time, their initial value is in protecting the bank surface.

-Contour Wattling

Contour wattling consists of long bundles of plant stems tied together with twine and anchored in shallow trenches with wooden stakes (Figure 3.8). When the stems develop root systems and mature, the plant (typically willows) establishes structural stabilization properties within the soil root structure. Protection from erosive flow velocities result from the protective armoring quality provided by the plant's stems and leaves.

This method, like live construction, provides good re-vegetation potential, but only applies to situations where bank slopes are 3:1 or flatter and local channel velocities 6 feet per second or less. Most of the study reach has flow velocities greater than 6 feet per second, therefore contour wattling will only be implemented on a limited basis.

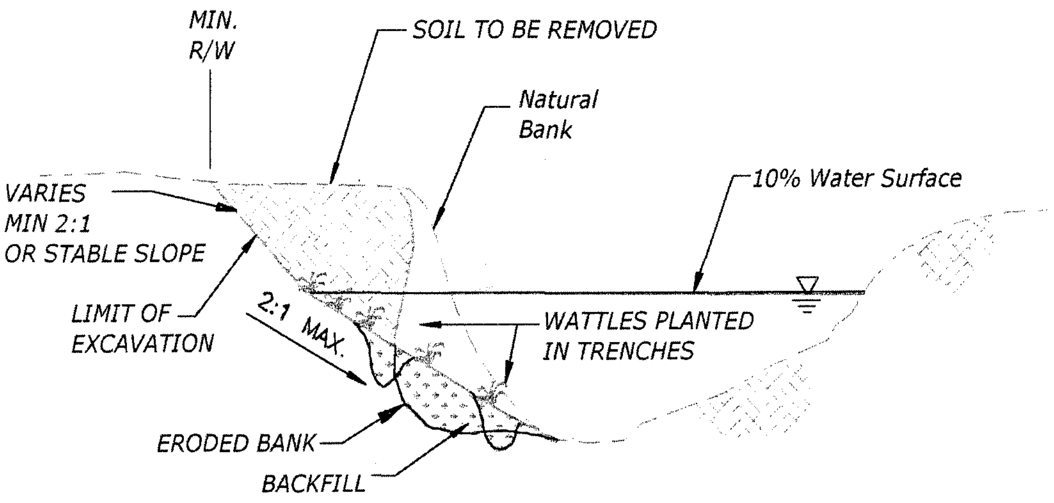


FIGURE 3.8
CONTOUR WATTLING

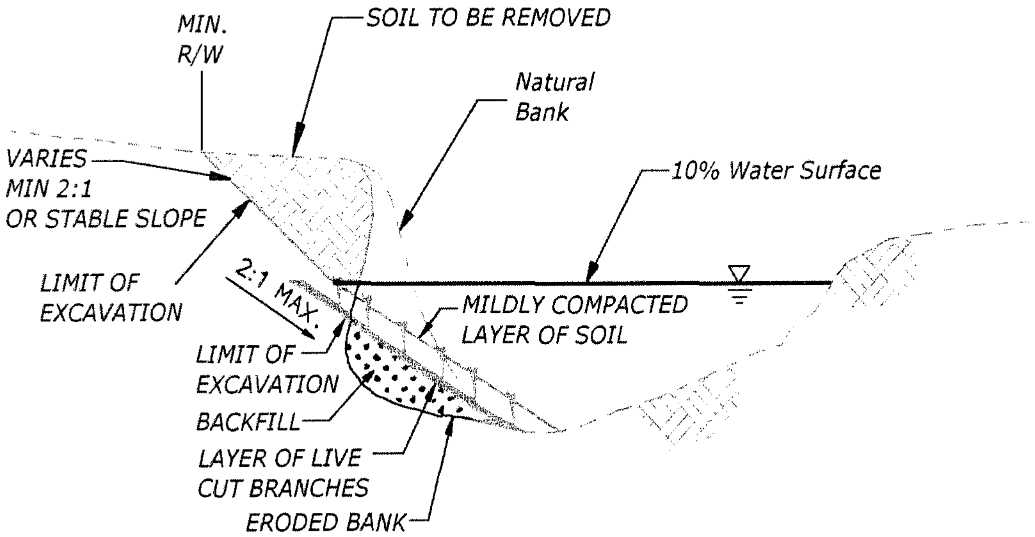


FIGURE 3.9
BRUSH LAYERING

-Brush Layering

Brush layering consists of placing live cut branches on the bank and covering them with a lightly compacted layer of soil (Figure 3.9). The tips of the branches extend out of the bank, thus slowing down overbank flow and trapping bank sediment. After the branches take root along their length, they begin to act like horizontal slope drains on the bank.

This method, like live construction, provides good re-vegetation potential, but applies to situations where bank slopes are 3:1 or flatter, and for relatively low velocities (6 feet per second or less).

-Bank Surface Matting (Erosion Mats)

Bank surface matting (erosion mats) consists of securing plastic, jute, or geotextile fabric surface liners to channel banks using stakes or staples (Figure 3.10). These materials provide soft armor protection against erosive velocities and are combined with live staking or direct seeding. Abrasive sediments and debris will wear, snag, and tear these fabrics with time, potentially undermining the structure. They work best in uniform improved channels with flat bank slopes. Similar to contour wattling, their application is limited to bank slopes of 3:1 or flatter, and local channel velocities of 12 feet per second or less. This method has good re-vegetation potential.

Biotechnical Slope Protection

Biotechnical Slope Protection combines live vegetation with armoring (inert) material to control erosion. Any armoring material that is porous or has openings can lend itself to Mixed Construction by planting it with some type of vegetation

-Root Wads and Boulders

The root wads and boulders repair method consists of placing tree root wads and interspersed boulders in eroding bends of the creek (Figures 3.11 and 3.12). The root wads are placed pointing against the flow (upstream) and the boulders (4 to 5 feet in diameter) are placed in between the wads to hold them in place and set the spacing between them. In addition to the boulders, a footer log is used to support the root wad from below and another log is placed over the root wad to hold it from above. The root wads used will have a minimum of 10 feet of tree trunk or bole still attached to the root, with a minimum of 80 percent of the length buried into the creek bank. This tree trunk adds stability to the repair. After the root wads, boulders, and supporting logs are put in place, soil is placed on top, sloped back, and live staked.

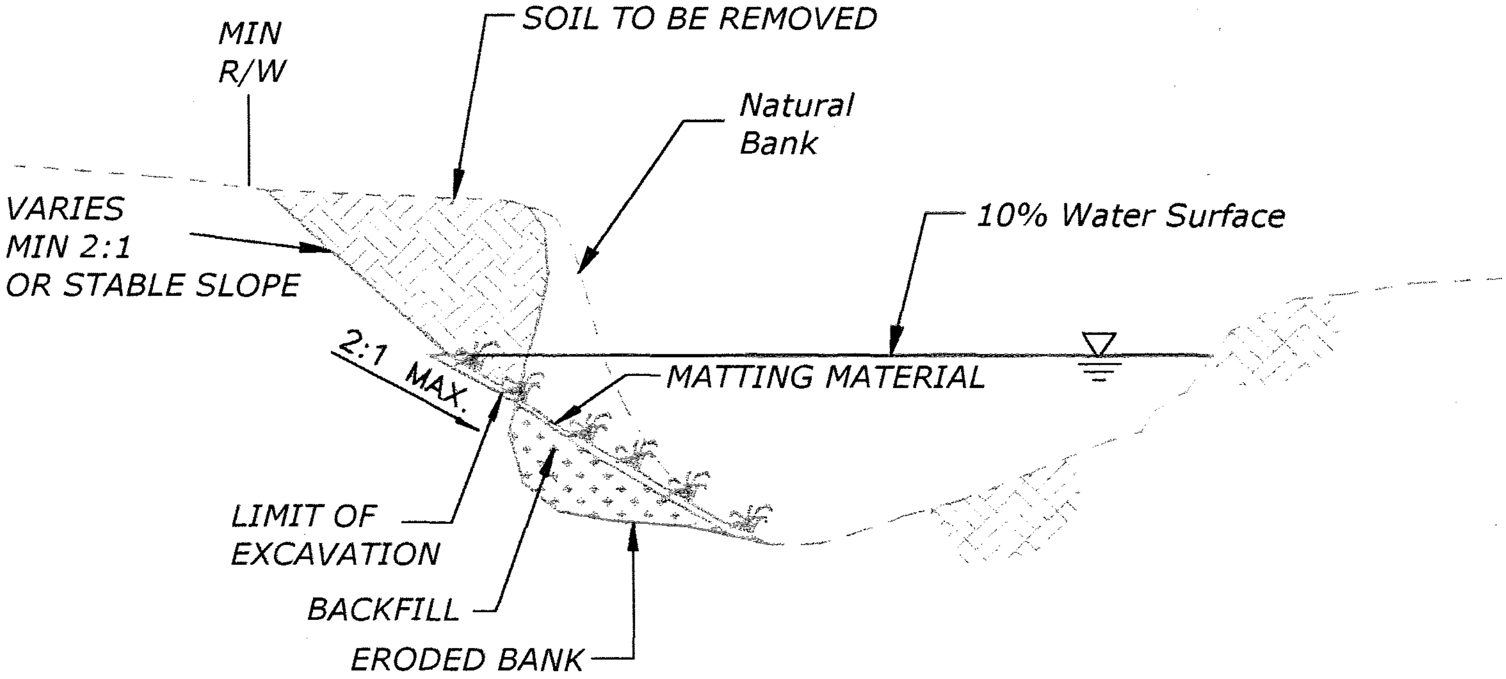


FIGURE 3.10
BANK SURFACE MATTING

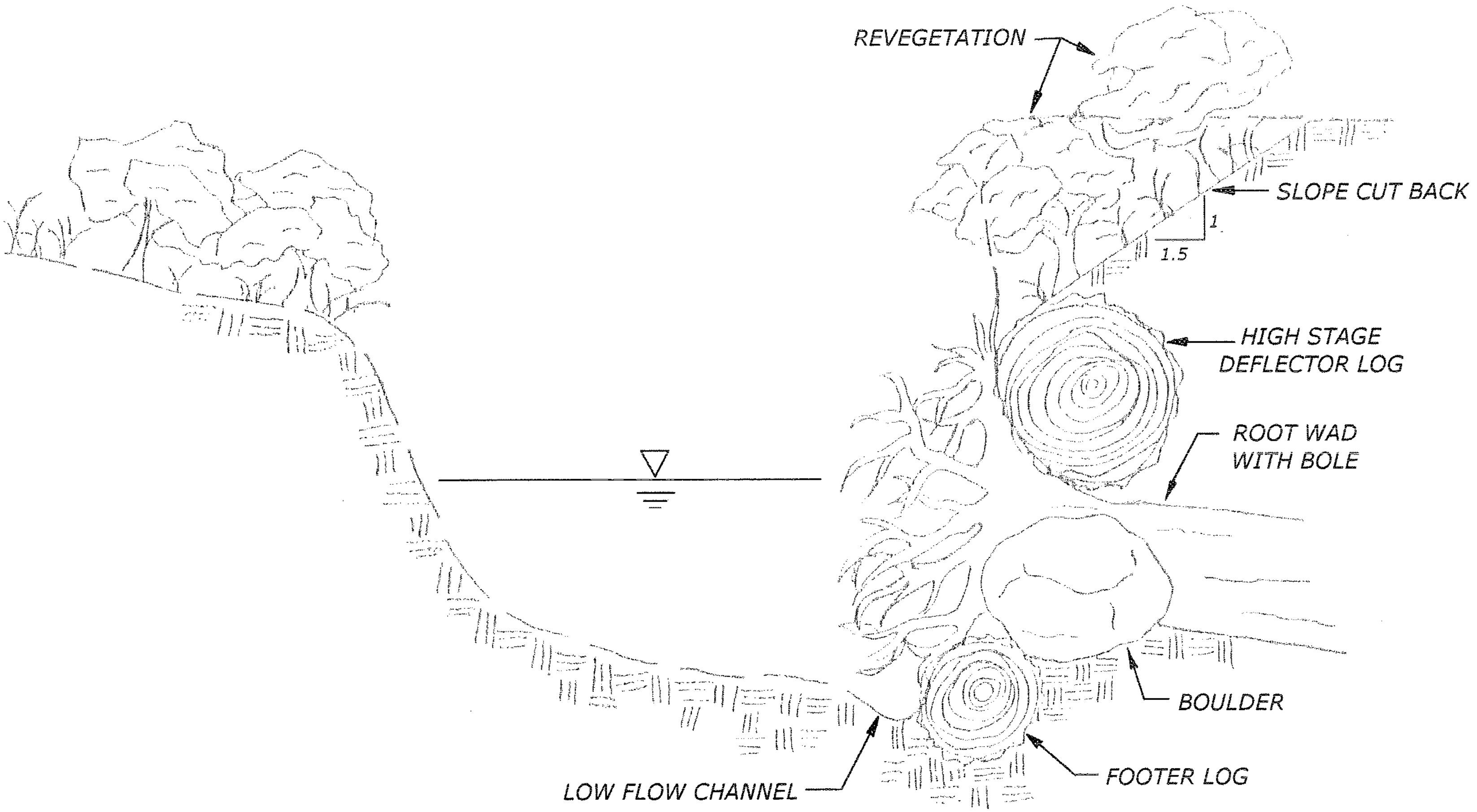


FIGURE 3.11
ROOT WADS AND BOULDERS

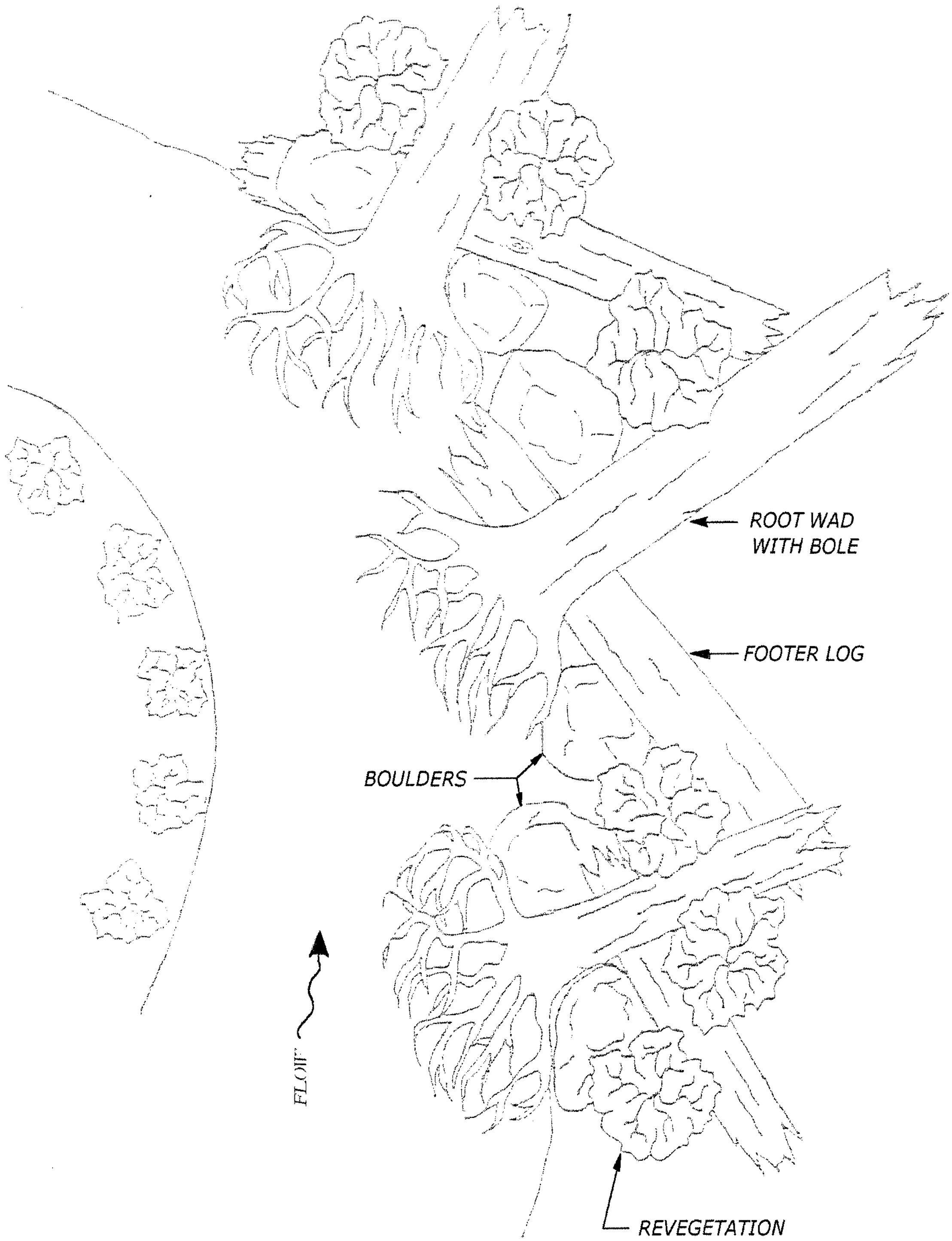


FIGURE 3.12
ROOT WADS AND BOULDERS

This method requires 80 percent embedment, or about 20 feet of depth horizontally into the bank, for installation. Straight sections and narrow bends of Calabazas Creek would not have enough area for installation. When installed correctly, this method can be applied where channel velocities are 10 feet per second or less. The longevity of this method is also governed by the type of trees that are used and the amount of time during the year that they are wet. The maximum decay rate occurs with alternate wetting and drying, or consistently damp conditions. It is unlikely that deciduous woods can be relied on to survive for more than 5 or 10 years. Sufficient anchoring boulders are placed over the root wads such that as the wood decays the boulders can settle and maintain the structural integrity of the embankment.

-Soil Cellular Confinement System

Soil Cellular Confinement System (GEOCELL) is a polyethylene plastic cellular system where structural strength is developed by the composite design of soil, plant roots, and the plastic cellular configuration (Figure 3.13). This system is available in 8-inch deep honeycomb mats that are installed in offset vertical layers to create terraced planting areas. The honeycomb terrace cells are filled with soil which is moderately compacted and planted with woody and herbaceous vegetation to augment structural qualities. This structure functions similar to a crib wall structure.

This material has been used to repair a variety of erosion problems ranging from slopes flatter than 2:1 with velocities less than 4 feet per second, to structural designs on steep slopes (up to ½ : l) experiencing velocities greater than 6 feet per second. This method has good re-vegetation potential, but not as good as Live Construction or Soil Bioengineering methods.

-Rock Riprap

Erosion is eliminated at the toe and on the bank slope by placing rock on the bank (Figure 3.14). Rock sizes can vary from 6 inches to 4 feet in diameter. This method applies to slopes that are 1 ½ :1 or flatter and flow velocities up to 15 feet per second.

Rock selected will be sufficiently large and uniform to enable soil to be placed between the rocks and planted by live staking or direct seeding. A biodegradable erosion mat may be used over the rock to help vegetation establishment depending on creek conditions at the location of the repair. Angular rock will be used because it tends to interlock making it more stable, which makes the revetment act like a single structure rather than a collection of independent stones. One advantage of a rock system is flexibility because it can settle and conform to the final streambed contour if scour occurs. Rocks also create habitat by providing refuge from high-flow velocities and creating scour holes.

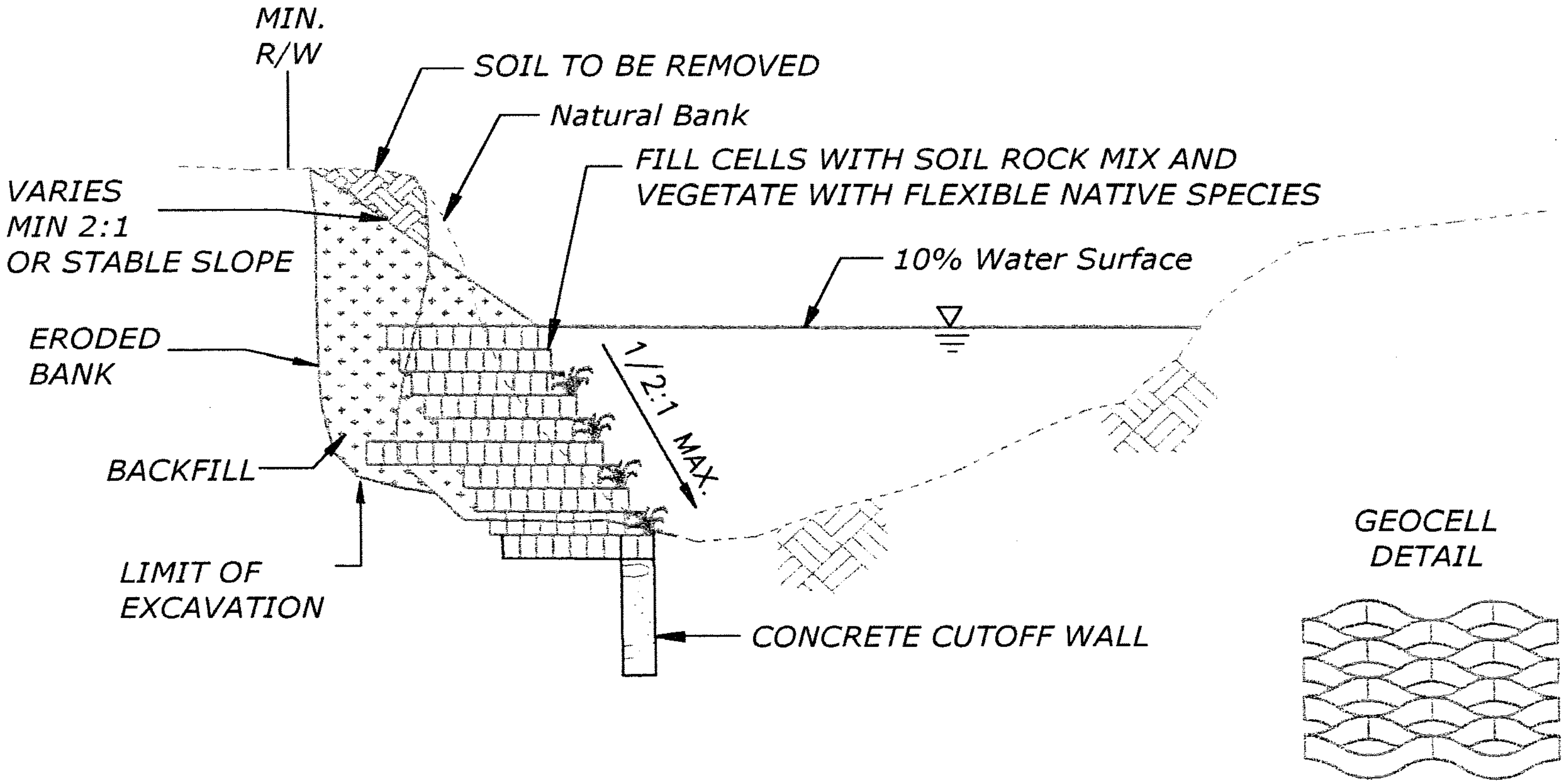


FIGURE 3.13
SOIL CELLULAR CONFINEMENT SYSTEM (GEOCELL)

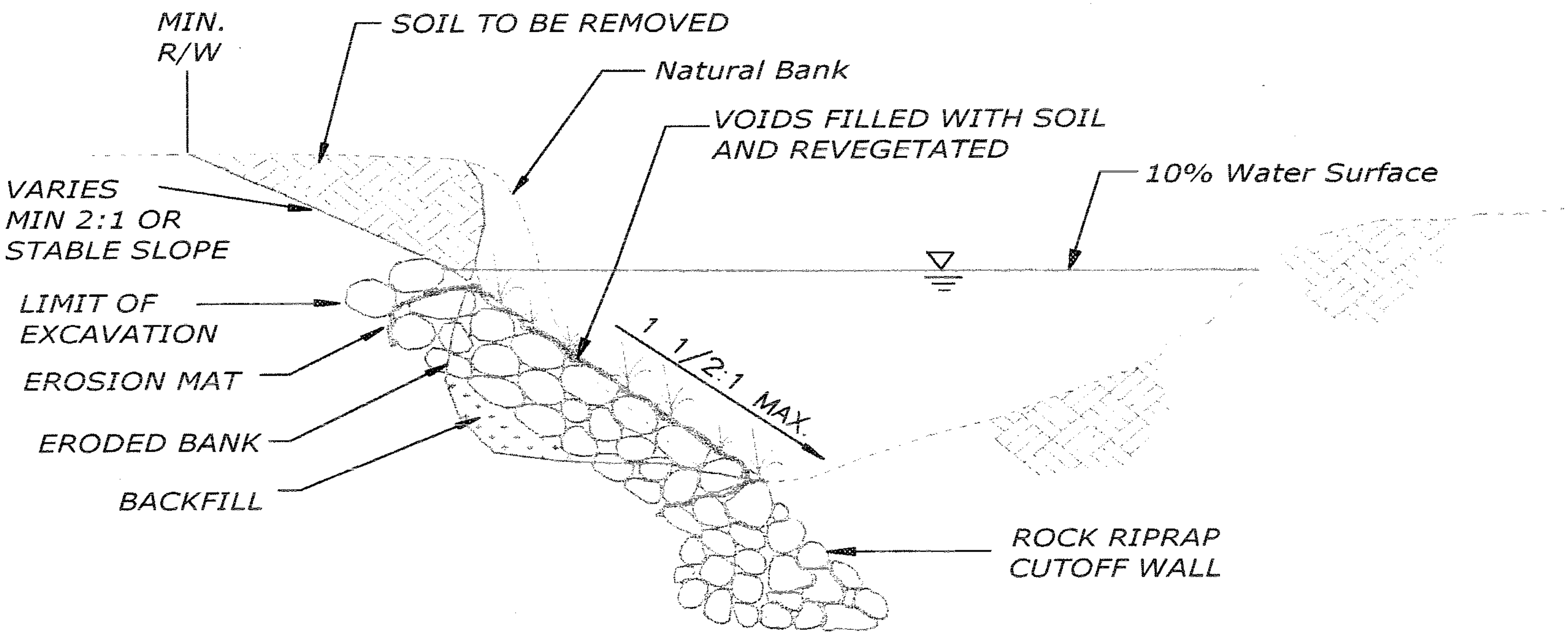


FIGURE 3.14
ROCK RIPRAP

This method has good re-vegetation potential, but slightly less than Soil Cellular Confinement System.

-Crib Walls

Crib walls consist of stacked interlocking concrete frames that form a retaining wall (Figure 3.15). The structural strength is developed by the composite design of a concrete frame with compacted backfill. Crib walls can be sloped up to ¼:1 and can withstand velocities up to 15 feet per second. Crib walls can be constructed with open face panels that are planted by live staking. Like articulated concrete block (ACB), crib walls restrict plant growth to the size of the panel opening, therefore re-vegetation is limited.

Armoring (Inert) Construction

Inert Construction consists of the sole use of hard armoring materials to protect an eroding channel bank. This type of construction has been widely used in the past due to its predictable properties, ease of installation, availability, and familiarity. These materials have no re-vegetation potential, and will only be applied after both Live Construction and Mixed Construction are found to not be feasible.

-Sacked Concrete Slope Protection

Sacked concrete slope protection (SCSP) consists of burlap bags filled with concrete and placed on channel banks (Figure 3.16). SCSP can be placed up to ½:1 side slope and requires a concrete or sacked cutoff wall at the toe of the bank. SCSP can withstand velocities up to 15 feet per second. Although SCSP does not provide any re-vegetation potential, it can be contoured to avoid trees and create planting wells.

-Gunite

Gunite is an air blown sand, cement, and water mixture placed directly on eroding channel banks (Figure 3.17). Its application permits near vertical side slopes and can withstand flow velocities up to 15 feet per second. Like SCSP, Gunite does not provide any re-vegetation potential, but it can be contoured to avoid trees and create planting wells.

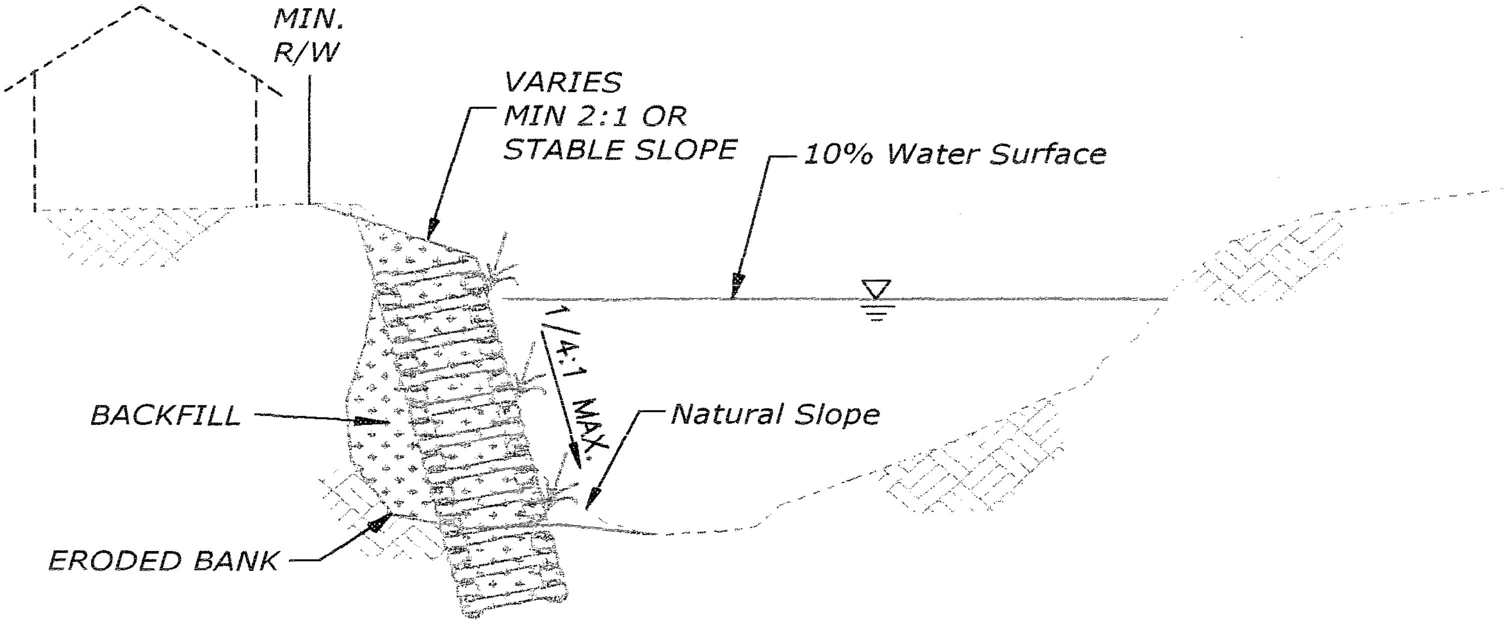


FIGURE 3.15
CRIB WALLS

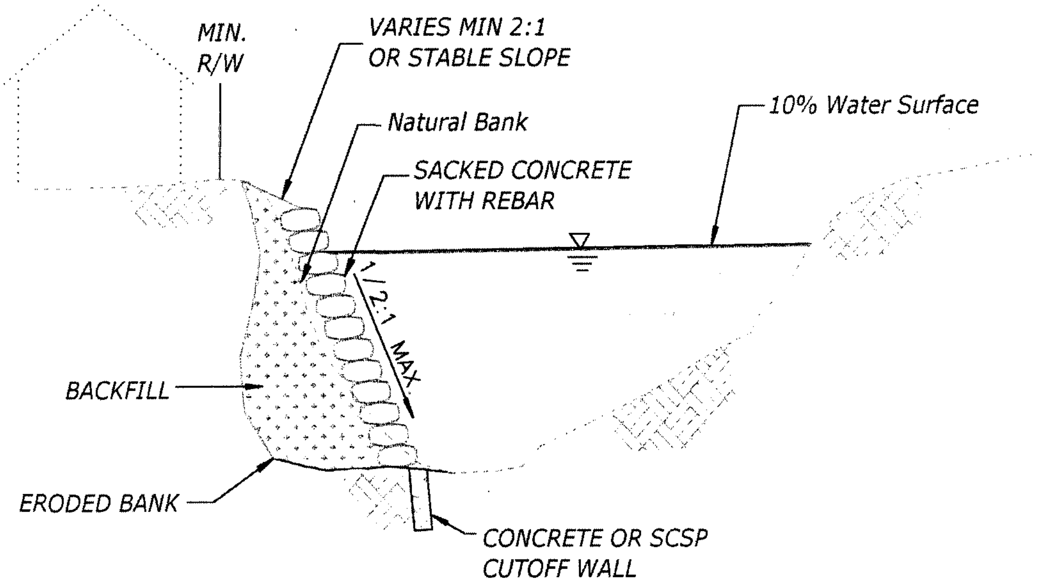


FIGURE 3.16
SACKED CONCRETE SLOPE PROTECTION

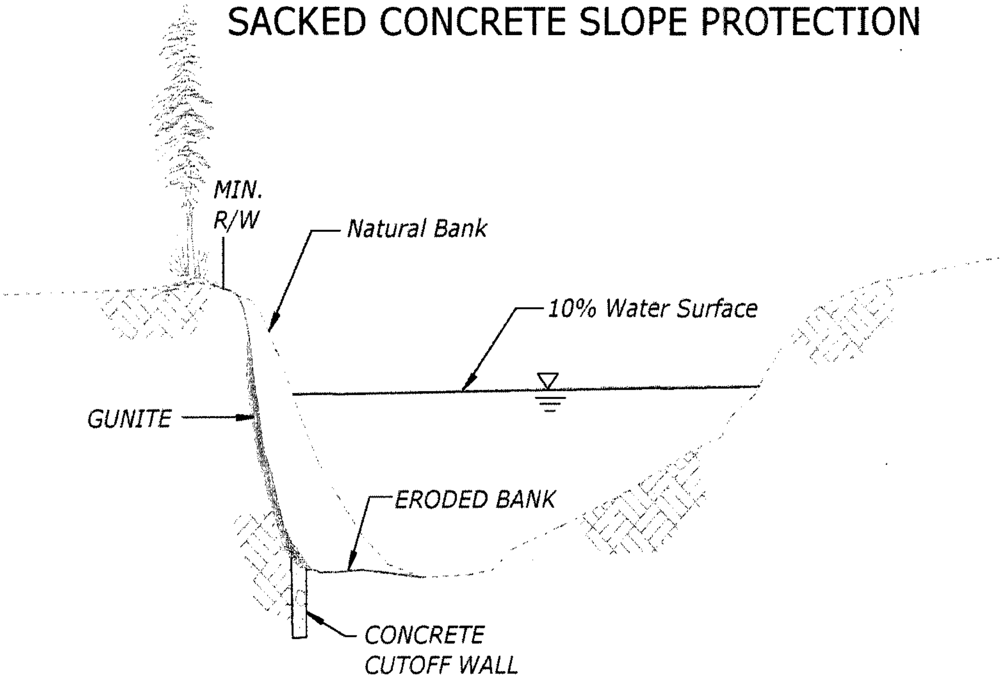


FIGURE 3.17
GUNITE

A summary of all of the remedial slope protection methods is shown in Table 3.3. Vortex rock weirs will also be installed as a remedial slope protection measure if channel degradation is causing bank erosion or if channel degradation threatens existing channel structures, existing erosion protection, or adjacent private improvements. Vortex rock weir materials will be constructed as described in the Preventative Slope Protection section (see Figures 3.6 and 3.7). Vortex rock weir construction will be considered as an alternative to bank slope protection or installed, where needed, in conjunction with slope protection.

Both channel bank and bottom protection need to be designed for each specific site. Examples of details that should be designed are (but not limited to): size of rock, thickness of rock, depth and configuration of gabions, depth of gabion cutoff wall, and GEOCELL anchor schedule.

When possible, slope protection will be installed without excavating into the existing eroding bank. Slope protection will match the upstream and downstream channel section by reestablishing the pre-erosion bank slope. This practice will eliminate impacts to existing vegetation and prevent erosion downstream. Proposed slope protection will be placed up to the 10 percent water surface elevation unless it is done as a preventative measure. Slope protection can be placed above the 10 percent water surface elevation if the existing site conditions warrant it. An example of this situation would be a house located at the top of the creek bank. The protection height will be determined on a case-by-case basis by District maintenance personnel.

If the selected slope protection method exceeds the space created by the bank erosion, one of the two following construction approaches can by applied: (1) excavate into the existing bank, or (2) move the center of the channel further away from the eroding bank.

1. A 2:1 minimum slope will be excavated back from the top of the slope protection where the District has ample right of way and no valuable native vegetation will be impacted (Figure 3.18). This procedure will establish a stable slope above the 10 percent water surface and will allow the District to replant native vegetation on the upper bank.

   A slope will not be excavated from the top of the slope protection where there is either insufficient right of way, structures, or valuable native vegetation that would be impacted (Figure 3.19). This approach protects the lower bank from further erosion, but allows the upper bank to find its own stable condition naturally without disturbing existing conditions.

2. If a point bar has developed on the bank opposite the eroded bank, then it could be excavated to reestablish a channel alignment that is closer to the opposite bank (Figure 3.20). Available right of way and existing vegetation would also need to be evaluated for this approach.

In any case, the channel bottom will not be narrowed beyond the upstream and downstream conditions. Narrowing the channel could cause channel bottom degradation, downstream erosion, and increased upstream water surface. If neither of the two above alternatives can be applied, another slope protection method will be considered.

Erosion protection measures protect for a finite period of time before deteriorating. Therefore, the District will repair existing erosion protection as necessary. If existing erosion protection completely fails, the District will reevaluate the site for alternative methods of protection before reconstruction.

Vegetation and Sediment Removal

Vegetation and sediment will be removed only if they cause an obstruction to flow. Whether the obstruction is due to vegetation, sediment, or debris, removal is initiated upon recognition that the channel capacity is compromised.

In unmodified channel sections, vegetation may be removed by hand labor, mechanical means, and/or aquatic herbicides from toe-to-toe of both banks (see Maintenance Standards, Table 3.4). In modified channel sections, vegetation may be removed by hand labor, mechanical means, and/or aquatic herbicides to the design height above the channel (see Maintenance Standards, Table 3.4). All Aquatic Herbicides used have been approved by California Department of Pesticide Regulations (formerly CAL EPA) and are applied by a state licensed vegetation technician.

In the vicinity of hydraulic structures, obstructions to flow such as accumulated vegetation, sediment, and debris will be removed. Hydraulic features include bridges, culverts, outfall structures, bypass structures, and drop structures.

When it is necessary to take maintenance vehicles into modified channels, the drop structures would be covered with gravel to allow passage of vehicles without damage to the structure or the vehicle. This gravel would be removed at the conclusion of the maintenance activities.

Fallen trees and debris obstructing flow will be removed along Calabazas Creek as necessary where the District has right of way. Vegetation on maintenance roads and ramps will be controlled by hand labor, herbicides, or mechanical means.

Table - 3.3 - Summary of Remedial Slope Protection Methods

Erosion Control Technique				
Category	**Method**	**Slope Requirements**	**Flow Velocity Requirements**	**Additional Information**
Live construction	Planting grasses, cuttings, transplants, live staking, seeding	3:1 or flatter	4 fps* or less	Not feasible on Calabazas Creek due to excessive channel velocities. Use on slope above 1.5-year water surface.
Mixed construction-soil bioengineering	Contour wattling	3:1 or flatter	6 fps or less	Plant roots protect soil. Creates benches or terraces (flat areas along bank). Limited use due to high creek velocities. Use on slope above 1.5-year water surface.
	Brush layering	3:1 or flatter	6 fps or less	Similar uses and restrictions to contour wattling. Requires large quantity of material.
	Bank surface matting	3:1 or flatter	12 fps or less	May be combined with live staking or direct seeding. Erosion matting is used to provide structure for plant growth. Requires maintenance and replanting to measure performance. Similar uses and restrictions to contour wattling. Best on uniform channel slopes.
Mixed construction-biotechnical slope protection	Root wads and boulders	Varies	10 fps or less	For use on the outside of eroding bends. Approximately 20 feet of horizontal depth into bank is needed for installation.
	Soil cellular confinement system (GEOCELL)	~½ :1 or flatter	6 fps or less	Cells are filled with soil and planted with vegetation. Matrix is not biodegradable.

Table - 3.3 Summary of Remedial Slope Protection Methods (Continued)

Erosion Control Technique		Slope Requirements	Flow Velocity Requirements	Additional Information
Category	Method			
Mixed construction-biotechnical slope protection	Rock riprap	~1½ :1 or flatter	15 fps or less	May be used for preventative as well as remedial protection. May be combined with live staking or direct seeding.
	Crib walls	¾ :1 or flatter	15 fps or less	Crib walls restrict plant growth due to size of openings. Use soil bioengineering above crib wall.
Armoring (Inert) construction	Sacked concrete slope protection	~½ :1 or flatter	15 fps or less	No re-vegetation potential.
	Gunite	All slopes to vertical	15 fps or less	No re-vegetation potential.

fps = feet per second local velocities, if unknown use 1.5 average velocity

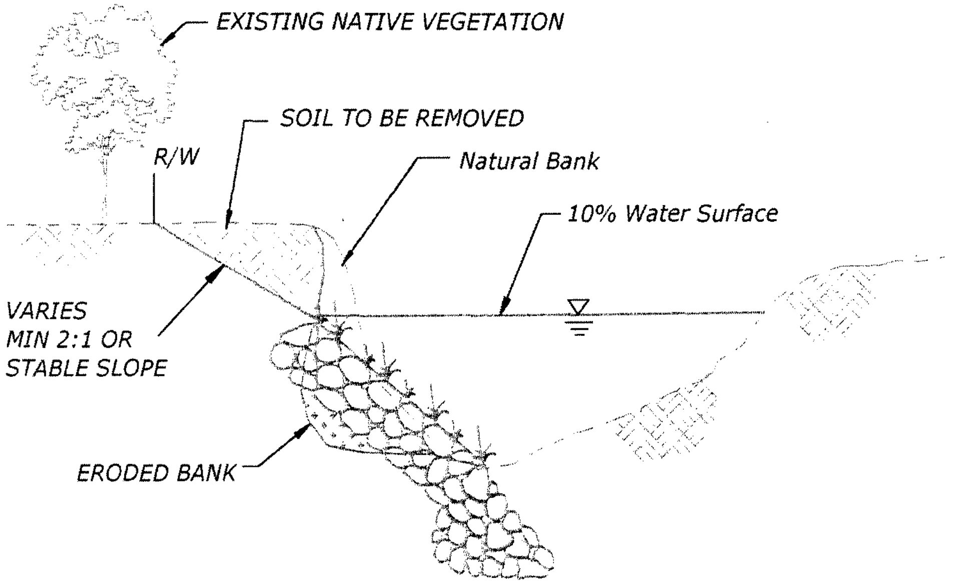


FIGURE 3.18
SLOPE CUTBACK
(ROCK RIPRAP AS EXAMPLE OF REMEDIAL SLOPE PROTECTION)

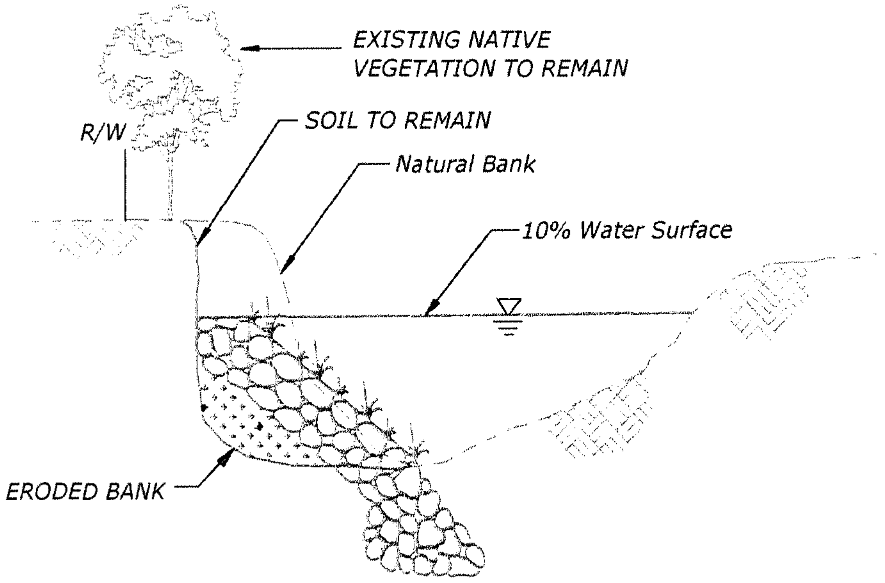


FIGURE 3.19
NO SLOPE CUTBACK
(ROCK RIPRAP AS EXAMPLE OF REMEDIAL SLOPE PROTECTION)

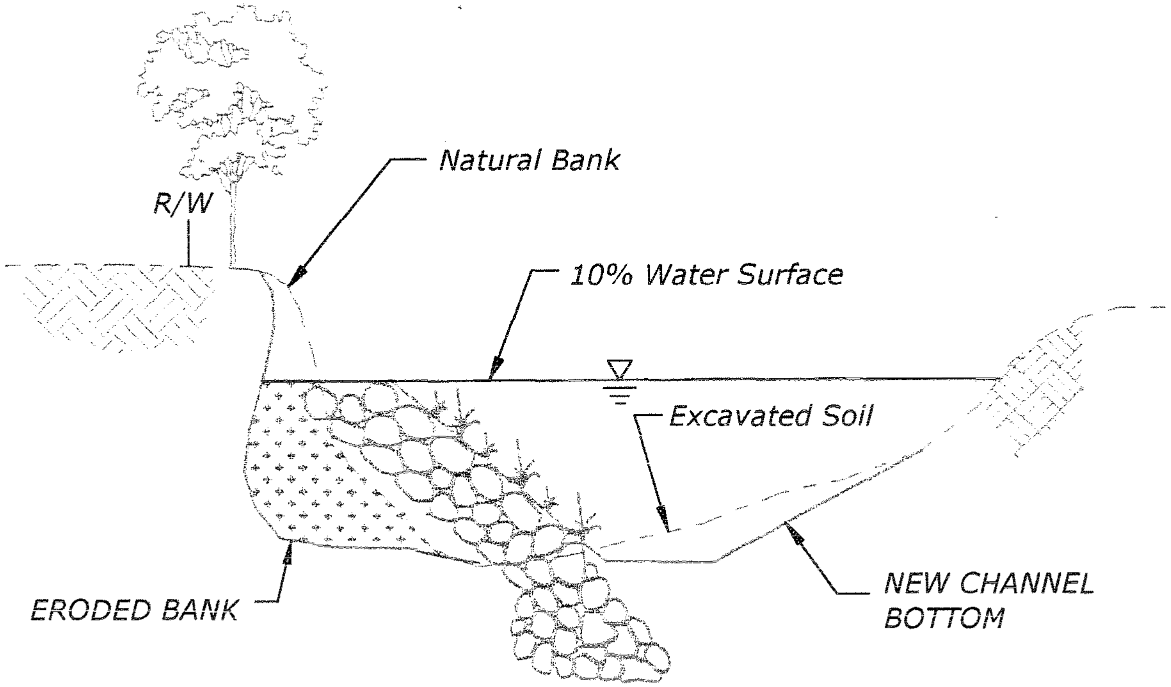


FIGURE 3.20
CHANNEL BOTTOM REALIGNMENT
(ROCK RIPRAP AS EXAMPLE OF REMEDIAL SLOPE PROTECTION)

Maintenance Activities Outlined By Reach

The following are maintenance activities, in addition to the above activities, that are specific to certain sections of Calabazas Creek: Reaches 26 to 33 (Miller Avenue to Comer).

Annual maintenance activities may include removal of large debris and fallen trees obstructing flow and construction and repair of erosion protection measures.

Periodic maintenance activities may include removal of vegetation and sediment in the waterway as described in the Maintenance Standards, Table 3.4. Concrete structures from upstream of Miller Avenue to Comer Drive will be inspected for abrasion and restored as necessary. Structural repair practices are outlined in Table 3.4. Channel access will be from ramps located at Miller, Rainbow, Blaney, and Prospect located on District-owned property adjacent to Calabazas Creek.

Only noninvasive erosion repair methods (no excavation) will be used in all Reaches as per resident request.

Maintenance Standards

Acceptable maintenance limits are based on Calabazas Creek design conditions. For modified creek sections, maximum levels of sediment and vegetation will be allowed within the flow area as long as the 1% storm design capacity is not exceeded. For unmodified creek sections or sections without proposed modifications, maximum levels of sediment and vegetation will be allowed within the flow area as long as it does not obstruct flow or prohibit the creek from being self-cleaning. These maximum levels are called acceptable maintenance limits and are listed in Table 3.4.

Table 3.4 - Calabazas Creek- Miller to End of Project Maintenance Standards for Vegetation and Sediment Removal

Facility	Maintenance Issue	Acceptable Maintenance Limit	Performance Criteria
Reaches 26 Through 33: Miller Avenue to Comer			
Unmodified Channel	Sediment accumulation	3.0-foot sediment depth	Remove sediment from channel bottom
	Woody vegetation	Woody vegetation occupies entire channel bottom	Remove by hand labor and aquatic herbicides to grade and chemically treat stumps from toe to toe of channel
Culverts	Concrete surface abrasion	Abrasion of 2 inches	Resurface
	Sediment accumulation	l.5-foot sediment depth	Remove sedimentation
All	Vegetation on roads or ramps	Present	Remove by mechanical means and aquatic herbicides to edge of road or ramp
	Vegetation overhanging roads or ramps	Present	Cut back overhanging vegetation to edge of road or ramp to a height of 12 feet
	Obstructions to flow	Present	Remove fallen trees and debris

4. Channel Restoration

Existing Conditions

The lower reaches of Calabazas Creek, between Miller Avenue and Prospect Road, are dominated by a healthy riparian canopy consisting of Coast Live oak (Quercus agrifolia), California buckeye (Aesculus californica) and Fremont cottonwood (Populus fremontii) with a predominately non-native understory. The majority of non-native species are common European, South African and South American grass species such as kikuyu grass (Pennisetum clandestinum) and ripgut grass (Bromus diandrus). There are also four aggressive non-native species found within the project area, acacia (Acacia sp.), giant reed (Arundo donax), French broom (Genista monspessulana) and English ivy (Hedera helix). The Acacia and Arundo exist in mostly isolated pockets but the ivy is present throughout. The French broom is limited in its occurrence but can spread rapidly if unchecked. These four species have the potential to overtake native vegetation, severely compromising the sustainability of the riparian community. Removal and/or control of these species would enhance the riparian vegetation community and help restore the creeks overall habitat value.

Calabazas Creek, although not a known steelhead stream, does potentially support some native and non-native fish species. The creek also supports a variety of amphibian species. California Red Legged frog (Rana aurora draytonii) and Yellow Legged frog (Rana boylii) have not been observed in the system but the upstream reaches of the project have the potential to support these species. The Pacific treefrog (Hyla regilla) is known to exist throughout the project area. The lack of pool structure and instream migration barriers throughout the project are considered the limiting factor to a healthy amphibian population.

Channel Restoration Conceptual Elements

The overall habitat value of the project reach can be restored and enhanced by the following:

- Removal of non-native species
- Native vegetation planting
- Creation of instream structure
- Removal of barrier to wildlife
- Comer Debris Basin Modification

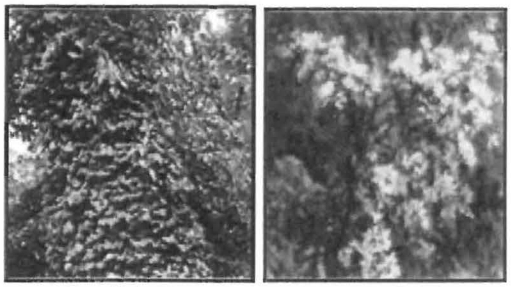
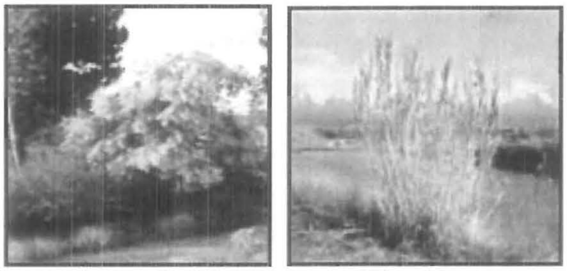

English Ivy French Broom

Figure 4.1

Removal of Non-native Species

The removal of non-native species would reduce the threat to native species since non-native species can spread rapidly. The non-native species aforementioned generally have a relatively shallow root as compared to native species. Removal of these species and replanting with native species would increase soil stability and reduce top soil loss. Generally, non-native species provide limited habitat for native wildlife. Removal of the non-native and replanting of natives would increase biodiversity, thereby increasing habitat value.



Acacia

Giant Reed

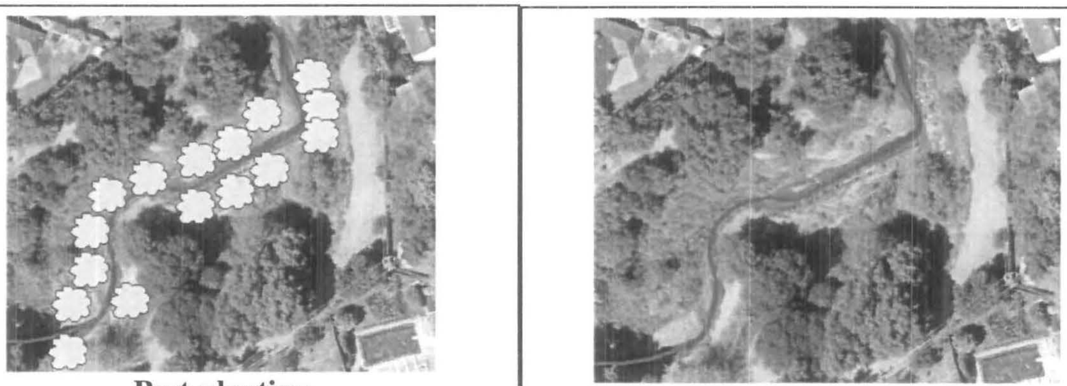
Figure 4.2

While removal of non-native species would be beneficial to the creek ecosystem, there are some concerns associated with this work. First, ingress and egress to some of the infestation sites may be limited since some of the areas have no maintenance road access for equipment or personnel. Second, the maintenance of these sites is generally long-term and, depending on access and the species being removed and controlled, can require significant resources.

Native Vegetation Planting

Although the majority of the creek maintains a healthy riparian corridor some areas lack canopy cover or have little vegetation. The planting of native trees and understory species in these areas would increase shaded riparian cover (potentially reducing water temperature and improving water quality), provide a continuous riparian corridor that would reduce habitat fragmentation and reduce erosion and top soil loss generally associated with bare soil areas.

The planting of native vegetation in areas that are lacking has the same concerns associated with it as the removal of non-native species. Ingress and egress to the sites and maintenance issues would need to be evaluated.



Post-planting

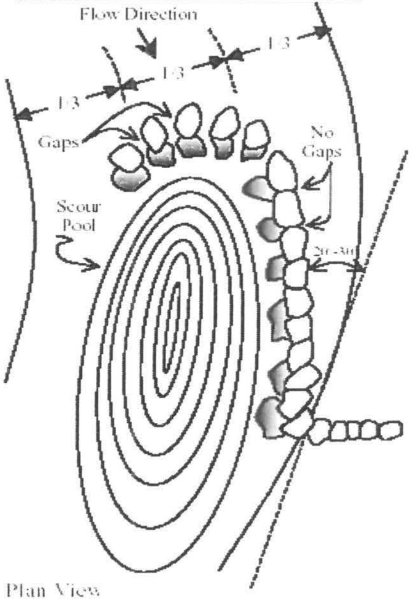
Pre-planting

Figure 4.3 Example of potential riparian planting

Creation of Instream Structure

The lack of instream structure is considered one of the limiting factors to the establishment and maintenance of healthy fish and amphibian populations in Calabazas Creek. The lack of instream structures, particularly instream pools, limits the amount of refuge available to fish and amphibian species during higher velocity flows and from predators. Pools provide aquatic species with an area where water velocity is considerably lower. High flows in areas lacking instream structure can essentially flush the existing aquatic species out of the area, severely reducing biodiversity.

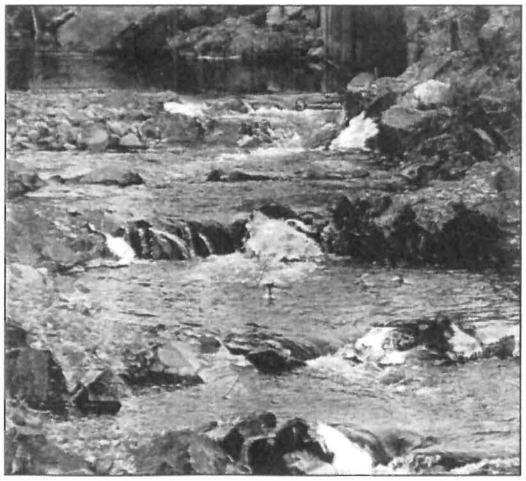
Figure 4.4 J-Hook Weir



The creation of instream structures would enhance the creeks aquatic resources providing areas of refuge from high flows and predators. This refuge would allow aquatic species to colonize and establish healthy populations throughout the project area, enhancing biodiversity and habitat value. The creation of instream structure can be integrated with bank stabilization and erosion control efforts which could reduce costs. Also, structures can be installed in those areas in need of grade control helping to balance sediment transportation through the system.

Some concerns associated with the creation of instream structure are: the effects on flood control, particularly conveyance of flow, and the ponding of water during dryer months and potential to provide breeding habitat for mosquitoes.

Figure 4.5 Stepped Pool Structure



Removal of Barriers to Wildlife

Along with the lack of instream structure, barriers to wildlife movement are considered a limiting factor to establishing and maintaining healthy populations of aquatic species. The majority of barriers on Calabazas Creek exist at the bridge crossings. Some bridge footings have significant drop-structures that aquatic species cannot pass over, limiting the animals range. Removal of the barriers at bridges would not entail removing or reconstructing bridges but creating structures that would reduce the impact of the drop-structures. For example, where possible, rocks can be placed to create a "ramp" for wildlife to move up thereby removing the barrier. Also, where appropriate, a series of stepped pools could be created which could greatly benefit fish species. Many other types of structures can be created depending on site conditions and need.

The creation of structures to reduce the impact of wildlife barriers would have to be balanced with flood control, erosion control and sediment transport efforts. Also, permitting of these structures could prove to be complicated due to ownership and regulatory issues.

One of Calabazas Creek's most recognizable in stream structures and barrier to wildlife is the Comer Debris Basin. The Basin has been allowed to fill with sediment since 1992, and removal has been encouraged by local residents. Modification and removal alternatives are included in this report to investigate the potential impacts such work will have on the channel morphology and riparian habitat downstream of the site.

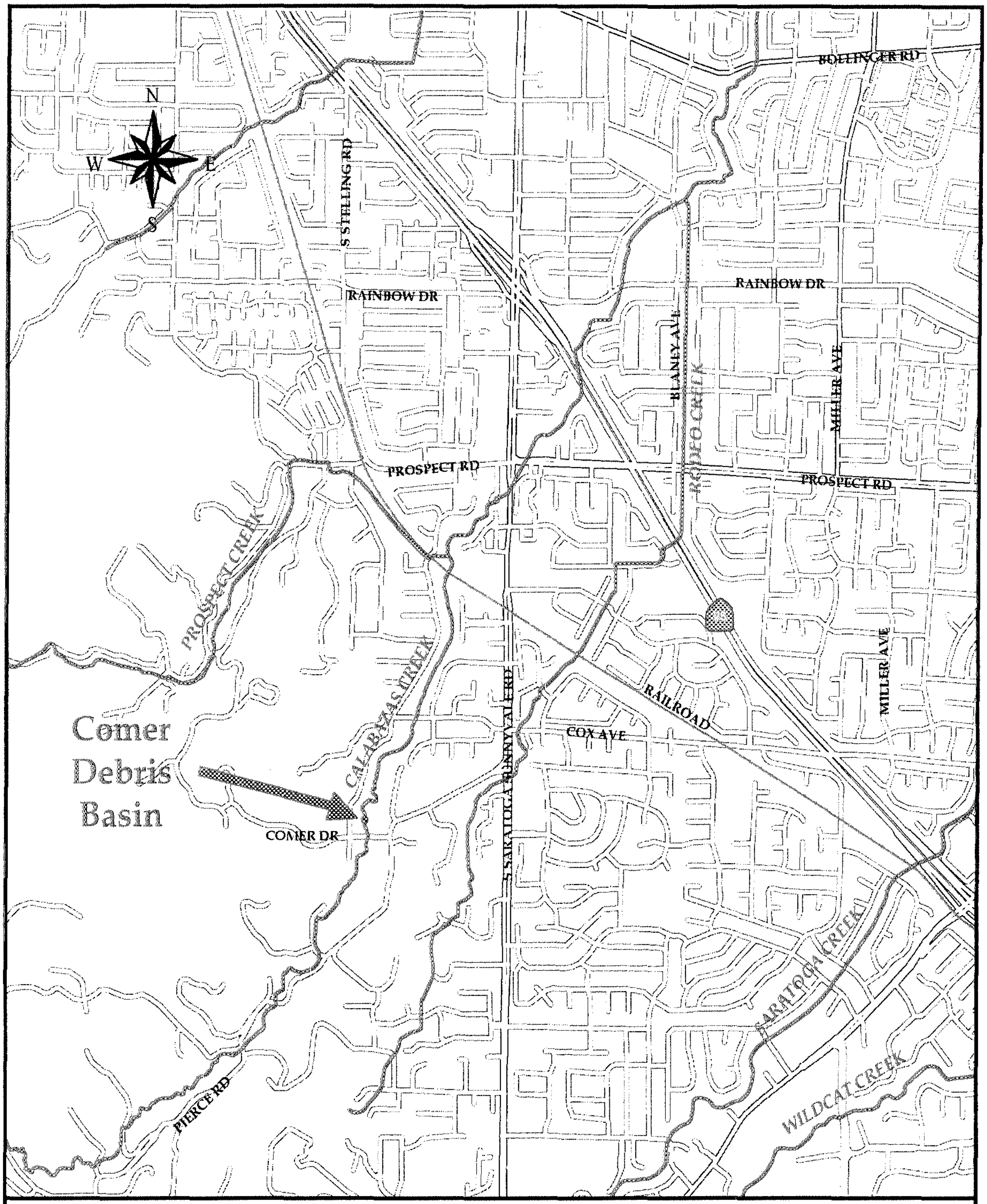
Comer Debris Basin Modification

This section summarizes the significant sediment transport impacts that would result from modification of the existing Comer Debris Basin on Calabazas Creek. An engineering feasibility study dated April 18, 2002, was performed by Jennedy/Jenks Consultants, who conducted a preliminary evaluation of existing conditions at the Comer Debris Basin with three additional constructible conceptual alternatives. All four constructible conceptual alternatives were assessed in terms of hydraulic, sediment transport, environmental and aesthetic impacts. The findings of the feasibility study have been merged into this report.

Project Background

The Comer Debris Basin is located on Calabazas Creek in Santa Clara County, as shown on Figure 4.6. The Santa Clara Valley Water District (District) constructed the basin in 1973 as a sediment collection facility consisting of a 12-foot high dam located approximately 300 feet downstream of the Comer Drive Bridge. The basin operated as a debris removal facility until 1992, when the District ceased maintenance operations to remove accumulated debris. The basin was allowed to fill after 1992, resulting in a reduction of clearance between the channel bottom and the Comer Drive Bridge from 10 feet to approximately 4 feet. Currently, the basin is characterized by an exposed surface of coarse sediment and little vegetation; debris and sediment flow through the basin and continue downstream.

This project was initiated by the District's West Watershed Operations Division at the request of the North Central Zone Advisory Committee and a member of the City of Saratoga City Council.



Calabazas Creek
Comer Debris Basin Location

Figure 4.6

Problem Definition

Comer Drive bridge will potentially flood during a 1% storm event. Sediment removal has not occurred since 1992, reducing the vertical clearance between the channel bottom and the Comer Drive Bridge from 10 feet to 4 feet. Because of this, flow could back up simply from a fallen tree or garbage dumped in the creek. Also, the concrete dam blocks sediment from going downstream in a normal manner, resulting in sediment deposition in the basin upstream of the dam. Depriving the creek from its normal supply of sediment has caused erosion downstream of the dam up to the Union Pacific Rail Road (UPRR) crossing. As a result of this, the District continues to repair the erosion damage in an effort to stabilize the artificially gravel-reduced creek, while at the same time removing accumulated sediment upstream of the dam. Mitigation of the creek stability problem in this fashion, however, will result in an increase in financial burden for the District over time.

Project Objectives

The objective of the Comer Debris Basin Engineering Feasibility Study was to evaluate the feasibility of removing or modifying the basin.

The feasibility study will be part of the development of a long-term plan for the watershed. The feasibility study is needed to ensure that the watershed plan includes information regarding the effects of the basin on sedimentation, environmental restoration, environmental enhancements, maintenance requirements, and repair of facilities.

Conceptual Alternatives

A comparative evaluation of basin removal/modification alternatives and existing conditions was conducted to assess whether removing or modifying the basin constitutes a benefit to the District. To assess the feasibility of removing the Comer Debris Basin, three alternatives were compared with existing conditions for impacts on channel hydraulic performance (See Table 4.1) as well as on possible changes to the current transport characteristics of stream sediment. This section summarizes the approach and results of the analysis (See Table 4.2).

Conceptual Alternative 1

Alternative Description

Under Conceptual Alternative 1, no new project would be implemented in the study area (See Figure 4.7). Flood flows would continue to overtop Comer Drive Bridge and inundate adjacent properties, resulting in flood-related damages to residences. Bank slope erosion would be protected as needed, Comer debris basin sediment removal, and maintenance practices would be continued.

Conceptual Alternative Analysis

This alternative does not meet all of the Calabazas Creek Project objectives.

Hydraulic Analysis

The HEC-RAS computer model was used to conduct the hydraulics analysis. (See Comer Debris Basin Feasibility Study for details). The HEC-RAS model was run for existing conditions and for this alternative. Results from the 100-year simulation were used to evaluate flood conveyance capacity.

This alternative indicates that the Comer Drive bridge is subject to overtopping (i.e., flow passes over the bridge top deck) under existing conditions to a depth of approximately 6 inches (See Figure 4.7).

Sediment/Erosion Analysis

The sediment transport analysis was performed for existing conditions using the results of the HEC-RAS hydraulics evaluation for the 2.3-year event. The analysis involved estimating an upstream sediment supply and passing that supply through the study reach to estimate where sediment deposition or erosion might occur (See Comer Debris Basin Feasibility Study for details).

This alternative indicates that sediment transport characteristics downstream of the location of the existing Comer Debris Basin dam remain the same if no action is taken (i.e., existing conditions). Downstream results are shown in Figures 4.14, 4.15 and 4.16. Existing conditions consist of an artificial deposition area behind the basin dam, and channel restoration through the basin area that does not result in a stable channel section would result in channel bed erosion.

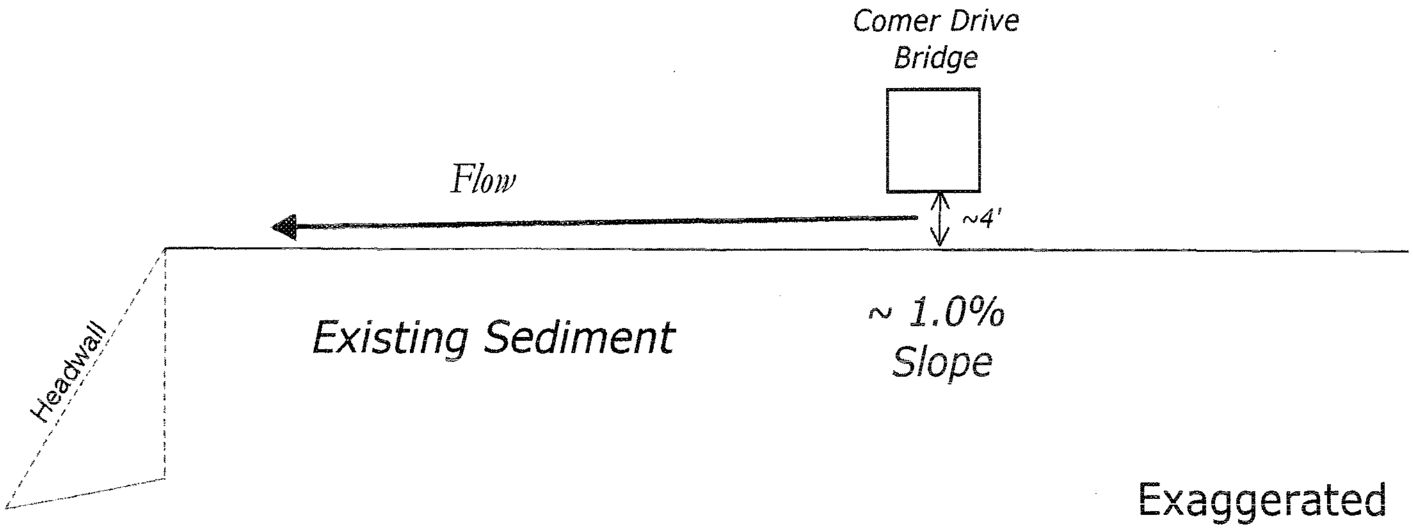
Environmental/Biological Analysis

No red-legged frog or western pond turtle habitat has been identified in the vicinity of the Comer Debris Basin. However, chorus frog tadpoles are found in the small pool of standing water at the base of the dam. Deer and Cooper's Hawks are also found, but they will continue to live in the scattered patches of shrubs, oak woodland and riparian habitat. The basin is an open area and provides little cover for habitat.

Costs

Cost for the No Project alternative is $0; however, cost for the annual maintenance and cleanup of the creek in the area of the Comer Debris Basin incurred by the District is ongoing. Since 1992, cleanup work and relocation of the accumulated sediment has occurred only occasionally as the Basin has been left alone for the most part. When an erosion problem or other issue is present at the Basin it is addressed on an as-needed basis.

FIGURE 4.7
Profile - Alternative 1: Existing Conditions



Exaggerated
Vertical
Perspective

Not To Scale

Conceptual Alternative 2

Alternative Description

Alternative 2 involves the following (See Figures 4.8, 4.9, and 4.10):

i. Demolish and remove the existing Comer Debris Basin dam, including retaining walls and wingwalls.

ii. Excavate the existing sediment behind the basin dam to a width to match the existing stream channel both upstream and downstream of the basin.

iii. Excavate the existing basin sediment to create a channel slope that matches the pre-dam construction (i.e., pre-1973) channel slope. This excavation would begin at the existing toe of the basin dam and extend approximately 1,300 feet upstream of the Comer Drive Bridge. The excavation would provide approximately 14 feet of clearance between the modified channel bottom and the underside of the Comer Drive Bridge.

iv. Stabilize the remaining basin sediment with added topsoil and plantings, which will match the riparian and upland vegetation habitat found both upstream and downstream of the basin. Channel features, including the area surrounding the 40-inch oak tree, would be stabilized using a combination of hard and soft-engineered systems designed to maintain the natural appearance of the restored section of the stream. Hard engineered systems include rock founded on buried concrete supports. Soft systems include mats and logs formed of material such as biodegradable coconut fiber. These soft systems would be used to line the creek channel and would support new plant growth until it is well established.

Conceptual Alternative Analysis

This alternative will meet all of the Calabazas Creek Project objectives.

Hydraulic Analysis

The HEC-RAS computer model was used to conduct the hydraulics analysis. (See Comer Debris Basin Feasibility Study for details). The HEC-RAS model was run for existing conditions and for this alternative. Results from the 100-year simulation were used to evaluate flood conveyance capacity.

This alternative indicates that the clearance between the lowest chord on the bridge and the restored channel bottom would be approximately 14 feet. The risk of flooding at Comer Drive Bridge would be removed during 1% storm event (See Table 4.1).

Sediment/Erosion Analysis

The sediment transport analysis was performed for existing conditions using the results of the HEC-RAS hydraulics evaluation for the 2.3-year event. The analysis involved estimating an upstream sediment supply and passing that supply through the study reach to estimate where sediment deposition or erosion might occur (See Comer Debris Basin Feasibility Study for details).

This alternative indicates that the sediment transport characteristics from upstream of Comer to the downstream section would show no change due to Comer Debris Basin modification. Downstream results are shown in Figures 4.14, 4.15 and 4.16. However, alternative 2 would be restored using the pre-dam construction stream profiles, which have been assumed to be an "equilibrium channel slope". The results for this alternative indicate a significant potential for erosion in the vicinity of the Comer Debris Basin where the slope is steeper.

Environmental / Biological Analysis

This alternative would provide an increase and improvement in available aquatic and terrestrial habitat in the area of the former Comer Debris Basin. The implementation of alternative 2 would result in the creation of 300 to 400 feet of shaded riverine aquatic (SRA) habitat along the restored stream channel in the location of the former debris basin. Also, it would provide for additional terrestrial habitat through the addition of approximately ½ acre of native upland vegetation.

Construction required for alternative 2 would cause short-term disruption of existing habitat. Disturbance would extend upstream of the Comer Drive bridge approximately 1,300 feet. Since the entire dam would be removed, pools of standing water will no longer be formed; therefore, new SRA habitat will be made available which will increase habitat opportunities for western pond turtle and other sensitive species.

Costs

Capital cost for alternative 2 is $1,250,000; however, existing operation & maintenance activities would continue. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal and sediment removal. Annual cost is approximately $ 14,500.

FIGURE 4.8
Plan View - Alternatives 2, 3, & 4

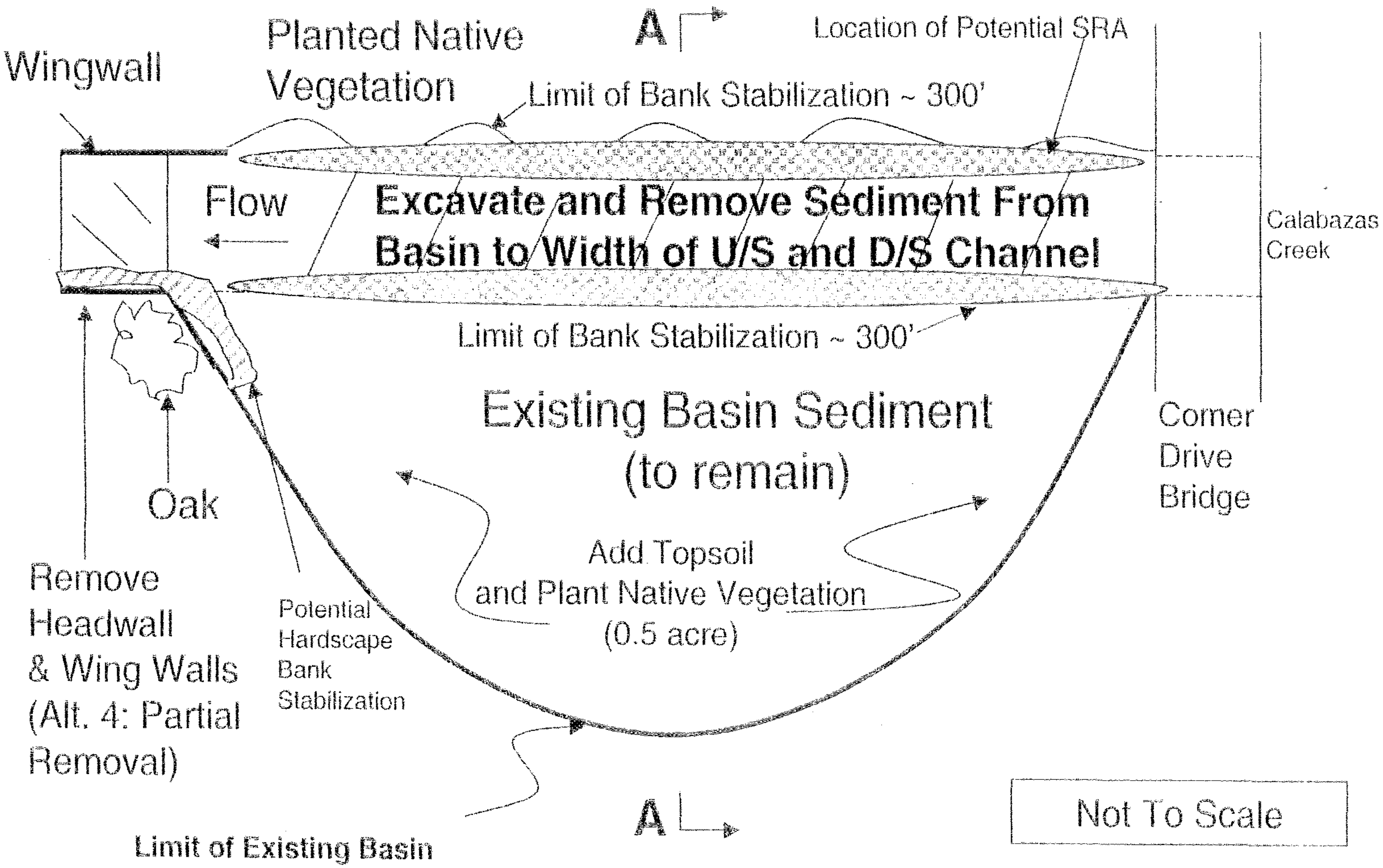

Planted Native Vegetation
A
Location of Potential SRA
Wingwall
Limit of Bank Stabilization ~ 300'
Flow
Excavate and Remove Sediment From Basin to Width of U/S and D/S Channel
Calabazas Creek
Limit of Bank Stabilization ~ 300'
Existing Basin Sediment (to remain)
Corner Drive Bridge
Oak
Add Topsoil and Plant Native Vegetation (0.5 acre)
Remove Headwall & Wing Walls (Alt. 4: Partial Removal)
Potential Hardscape Bank Stabilization
A
Not To Scale
Limit of Existing Basin

FIGURE 4.9
Section View - Alternatives 2 & 3

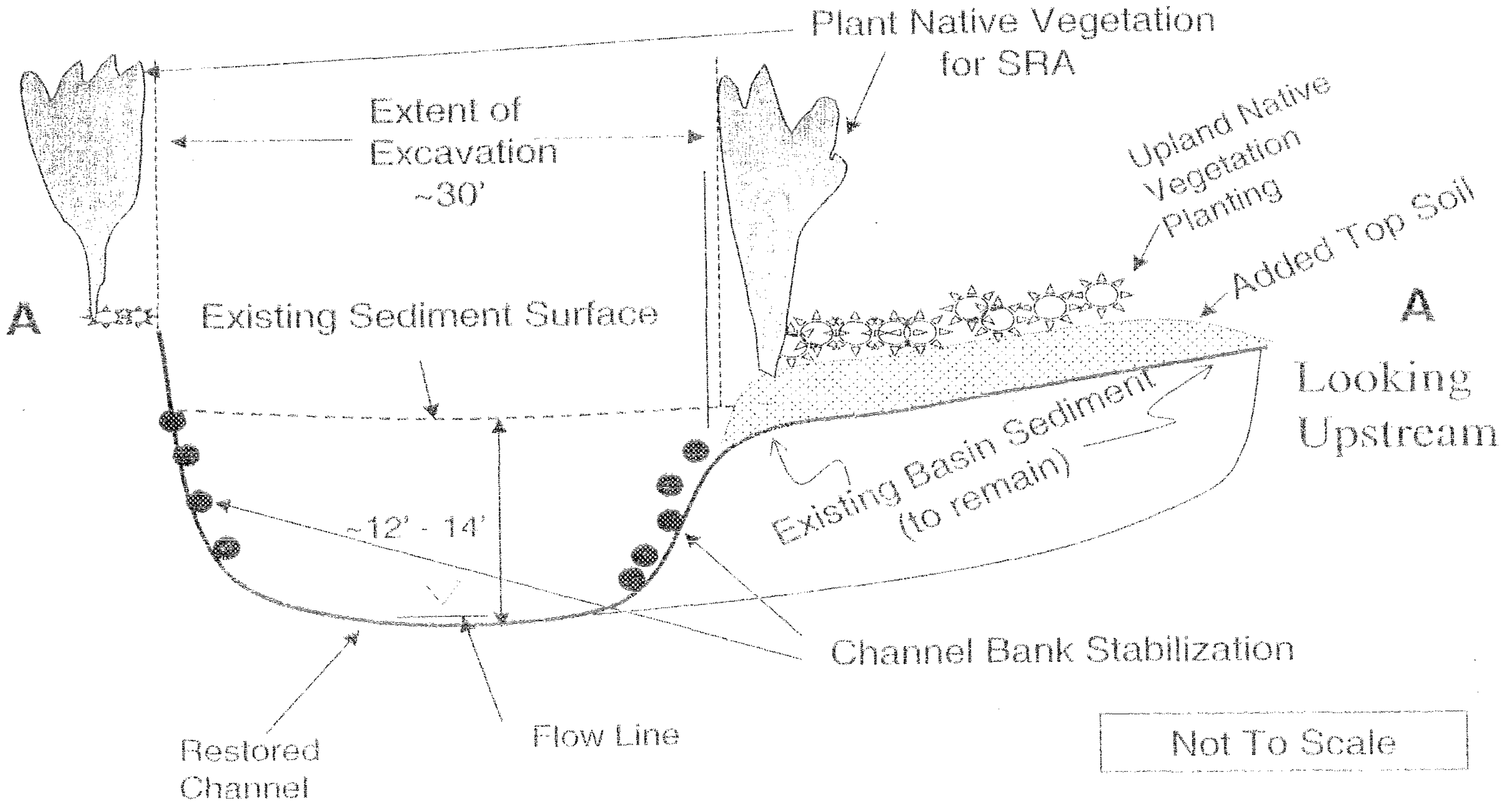
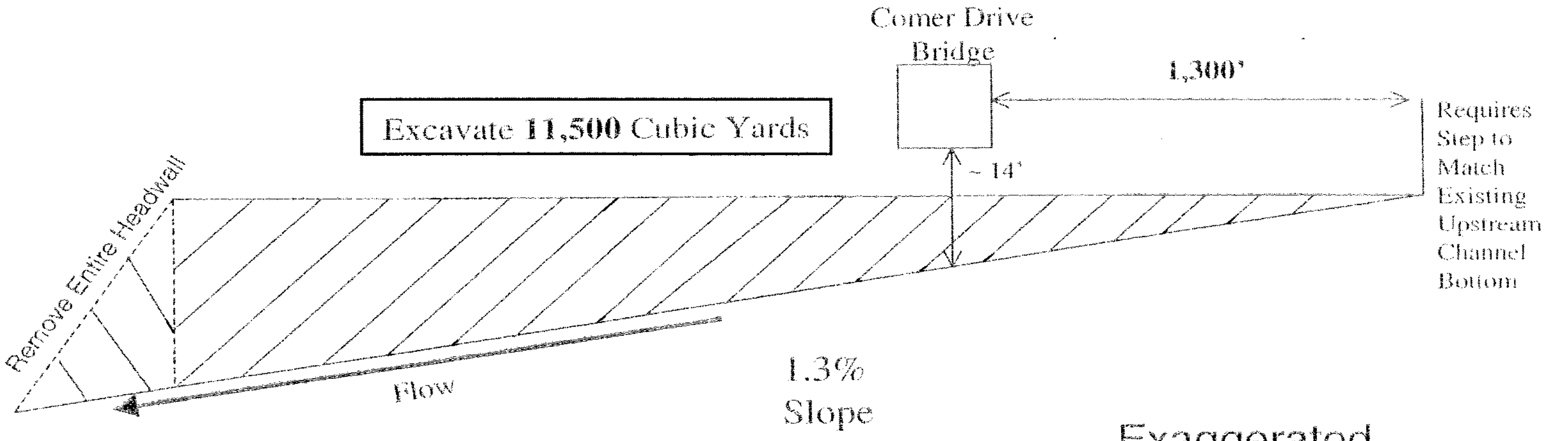

Plant Native Vegetation for SRA
Extent of Excavation ~30'
Upland Native Vegetation Planting
Added Top Soil
A
A
Existing Sediment Surface
Looking Upstream
Existing Basin Sediment (to remain)
~12' - 14'
Channel Bank Stabilization
Restored Channel
Flow Line
Not To Scale

FIGURE 4.10
Profile - Alternative 2


Comer Drive Bridge
1,300'
Excavate **11,500** Cubic Yards
Requires Step to Match Existing Upstream Channel Bottom
~ 14'
Remove Entire Headwall
Flow
1.3% Slope

Exaggerated Vertical Perspective

Not To Scale

Conceptual Alternative 3

Alternative Description

Alternative 3 uses the same approach as Alternative 2 for Items i, ii, and iv. Item iii would be modified for Alternative 3, as follows (See figures 4.8, 4.9 and 4.11):

i. Same as alternative 2

ii. Same as alternative 2

iii. Excavate the existing basin sediment with a series of at least two steps no more than 2-feet in height, which would create shallow pools and riffles (i.e., small falls) in the stream channel. These steps would be constructed between the location of the existing dam and the Comer Drive Bridge, and they would be separated by approximately 100 feet. The pools and riffles formed by these steps would add to aesthetic qualities in the stream reach, and the required extent of excavation upstream of the Comer Drive Bridge would be reduced to approximately 500 feet. This configuration of channel bed would also provide approximately 12 feet of clearance between the modified channel bottom and the underside of the Comer Drive Bridge.

iv. Same as alternative 2

Conceptual Alternative Analysis

This alternative will meet all of the Calabazas Creek Project objectives.

Hydraulic Analysis

The HEC-RAS computer model was used to conduct the hydraulics analysis. (See Comer Debris Basin Feasibility Study for details). The HEC-RAS model was run for existing conditions and for this alternative. Results from the 100-year simulation were used to evaluate flood conveyance capacity.

The model indicates that the clearance between the lowest chord of the bridge and the restored channel bottom for this alternative would be approximately 12 feet. The risk of flooding at Comer Drive Bridge would be removed during the 1% storm event (See table 4.1 for a summary of the results).

Sediment/Erosion Analysis

The sediment transport analysis was performed for existing conditions using the results of the HEC-RAS hydraulics evaluation for the 2.3-year event. The analysis involved estimating an upstream sediment supply and passing that supply through the study reach to estimate where sediment deposition or erosion might occur (See Comer Debris Basin Feasibility Study for details).

The model indicates that the sediment transport characteristics from upstream of Comer to the downstream section for this alternative would show no change due to Comer Debris Basin modification. Downstream results are shown in Figures 4.14, 4.15 and 4.16. However, alternative 3 would be restored using the step channel construction stream profiles, which are based on an assumed "equilibrium channel slope". The results for this alternative indicate reduced erosion when compared with alternative 2 in the vicinity of the Comer Debris Basin.

Environmental/Biological Analysis

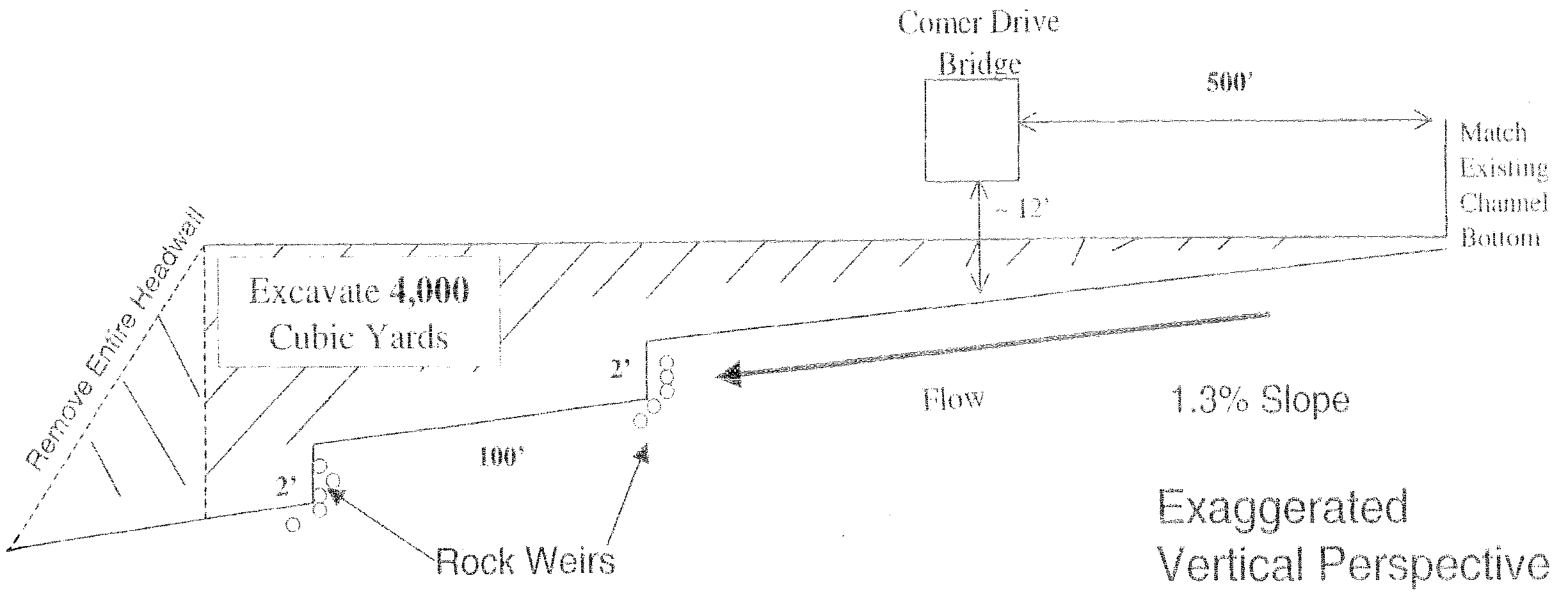
This alternative is similar to alternative 2. It would provide an increase and improvement in available aquatic and terrestrial habitat in the area of the former Comer Debris Basin. The implementation of alternative 3 would result in the creation of 300 to 400 feet of shaded riverine aquatic (SRA) habitat along the restored stream channel in the location of the former debris basin. Also, it would provide for additional terrestrial habitat through the addition of approximately ½ acre of native upland vegetation.

Construction required for alternative 3 would cause short-term disruption of existing habitat. Disturbance would extend upstream of the Comer Drive Bridge approximately 500 feet only. The entire dam would be removed, but two pools of standing water, each with an area of approximately 1,600 square feet, would form on the step channel at the base of each grade control structure during wet months. The new SRA habitat will increase habitat opportunities for western pond turtle and other sensitive species, while at the same time retain the existing aquatic pool habitat. This alternative would result in desirable aesthetic improvements through the formation of a series of small falls and pools.

Costs

Capital cost for alternative 3 is $890,000; however, existing operation & maintenance activities would be continue. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal and sediment removal. Annual cost is approximately $ 20,000.

FIGURE 4.11
Profile - Alternative 3


Comer Drive Bridge
500'
Match Existing Channel Bottom
~ 12'
Remove Entire Headwall
Excavate **4,000** Cubic Yards
2'
2'
100'
Flow
1.3% Slope
Rock Weirs
Exaggerated Vertical Perspective

Not To Scale

Conceptual Alternative 4

Alternative Description

Alternative 4 uses the same approach as Alternative 2 for Items i, ii, and iv. Item iii would be modified for Alternative 4, as follows (See figure 4.8, 4.12 and 4.13):

i. Same as alternative 2

ii. Same as alternative 2

iii. Remove the upper 3 feet of the basin dam headwall and leave the existing retaining walls, as shown in Figures 4.12 and 4.13. Existing basin sediment would be excavated to a depth 3 feet below the existing basin surface elevation; sediment excavation would extend approximately 50 feet upstream of the Comer Drive bridge, where a channel step would be constructed upstream of Comer Drive to match to the existing channel bed. Channel stabilization and re-vegetation would be conducted using the same methods and materials specified for Alternatives 2 and 3.

iv. Same as alternative 2

Conceptual Alternative Analysis

This alternative will meet all of the Calabazas Creek Project objectives.

Hydraulic Analysis

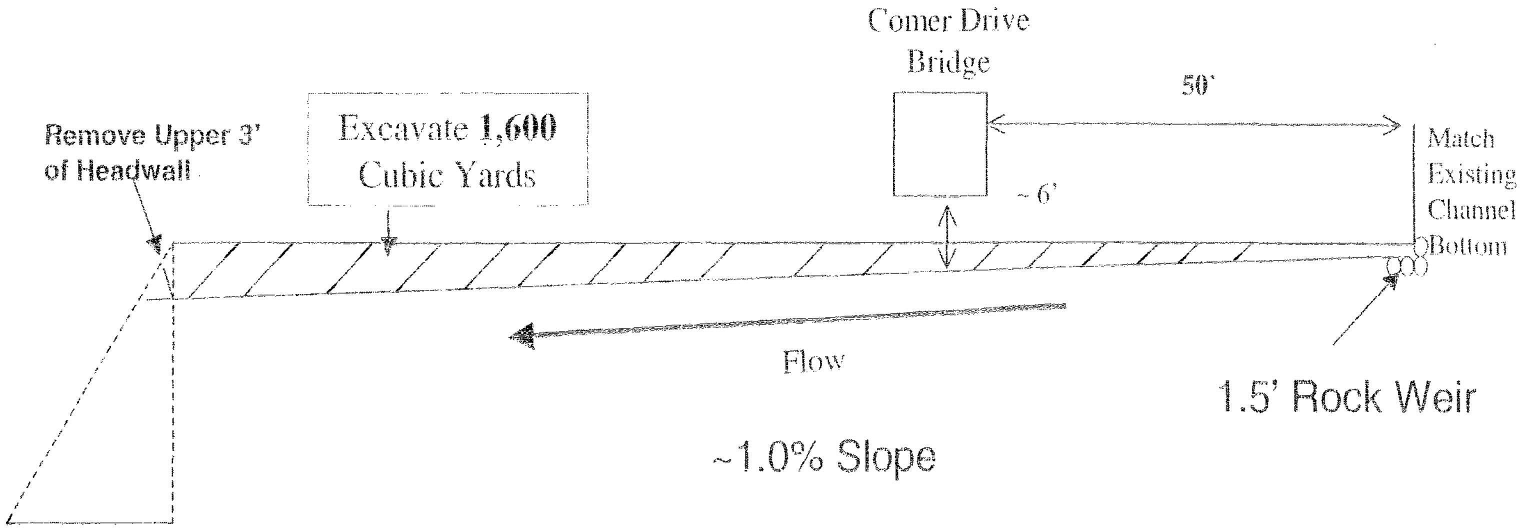
The HEC-RAS computer model was used to conduct the hydraulics analysis (See Comer Debris Basin Feasibility Study for details). The HEC-RAS model was run for existing conditions and for this alternative. Results from the 100-year simulation were used to evaluate flood conveyance capacity.

The model indicates that the clearance between the lowest chord on the bridge and the restored channel bottom for this alternative would be approximately 6 feet. The risk of flooding at Comer Drive Bridge would be removed during the 1% storm event (See table 4.1 for a summary of the results).

Sediment/Erosion Analysis

The sediment transport analysis was performed for existing conditions using the results of the HEC-RAS hydraulics evaluation for the 2.3-year event. The analysis involved estimating an upstream sediment supply and passing that supply through the study reach to estimate where sediment deposition or erosion might occur (See Comer Debris Basin Feasibility Study for details).

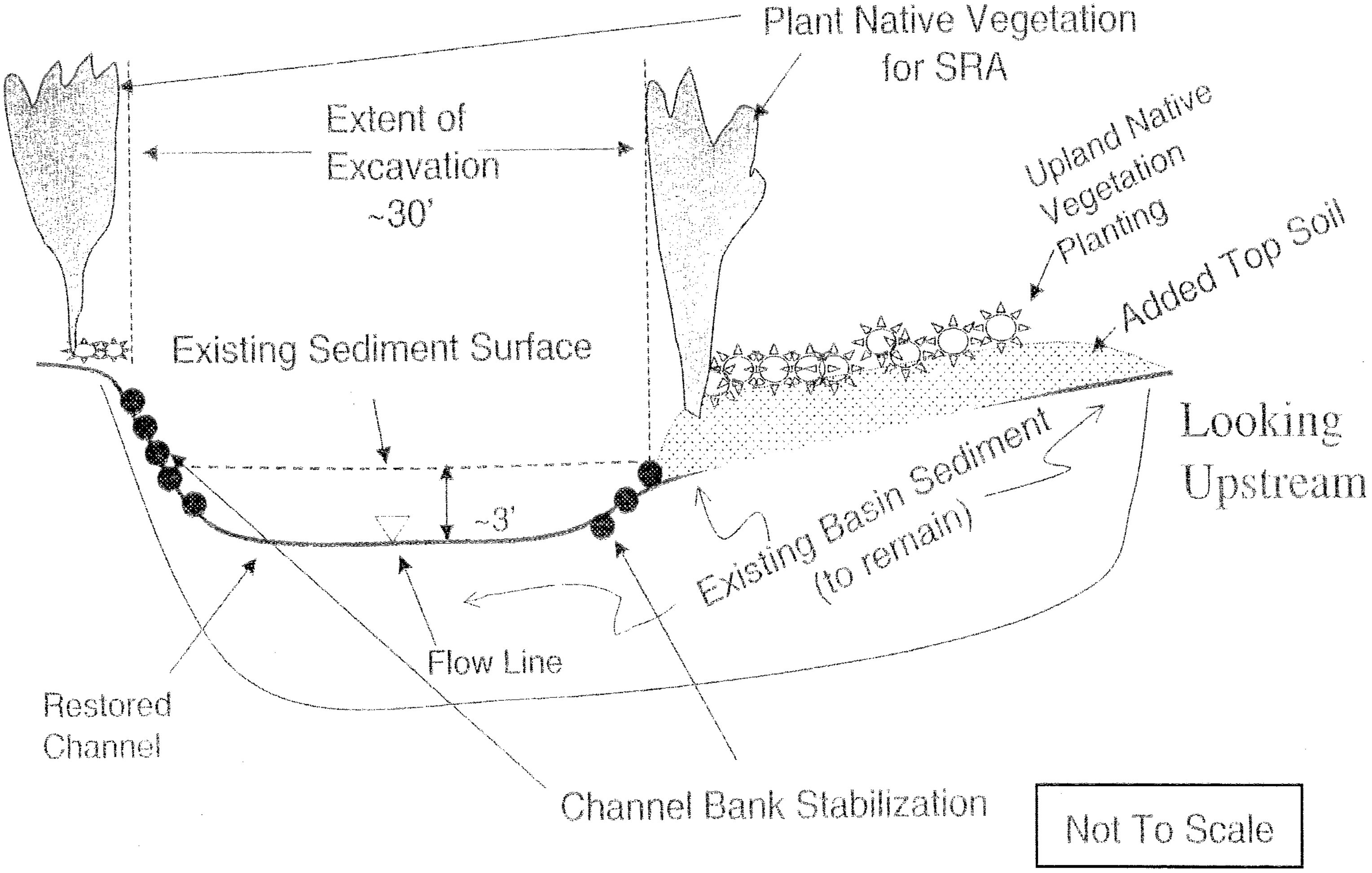
FIGURE 4.12
Profile - Alternative 4



Exaggerated
Vertical Perspective

Not To Scale

FIGURE 4.13
Section View - Alternative 4


Plant Native Vegetation for SRA
Extent of Excavation ~30'
Upland Native Vegetation Planting
Added Top Soil
Existing Sediment Surface
Looking Upstream
~3'
Existing Basin Sediment (to remain)
Flow Line
Restored Channel
Channel Bank Stabilization
Not To Scale

The model indicates that the sediment transport characteristics from upstream of Comer to the downstream section for this alternative would show no change due to Comer Debris Basin modification. Downstream results are shown in Figures 4.14, 4.15 and 4.16. However, alternative 4 was developed to minimize the required volume of excavation of existing basin sediment and is not based on an "equilibrium channel slope".

Environmental/Biological Analysis

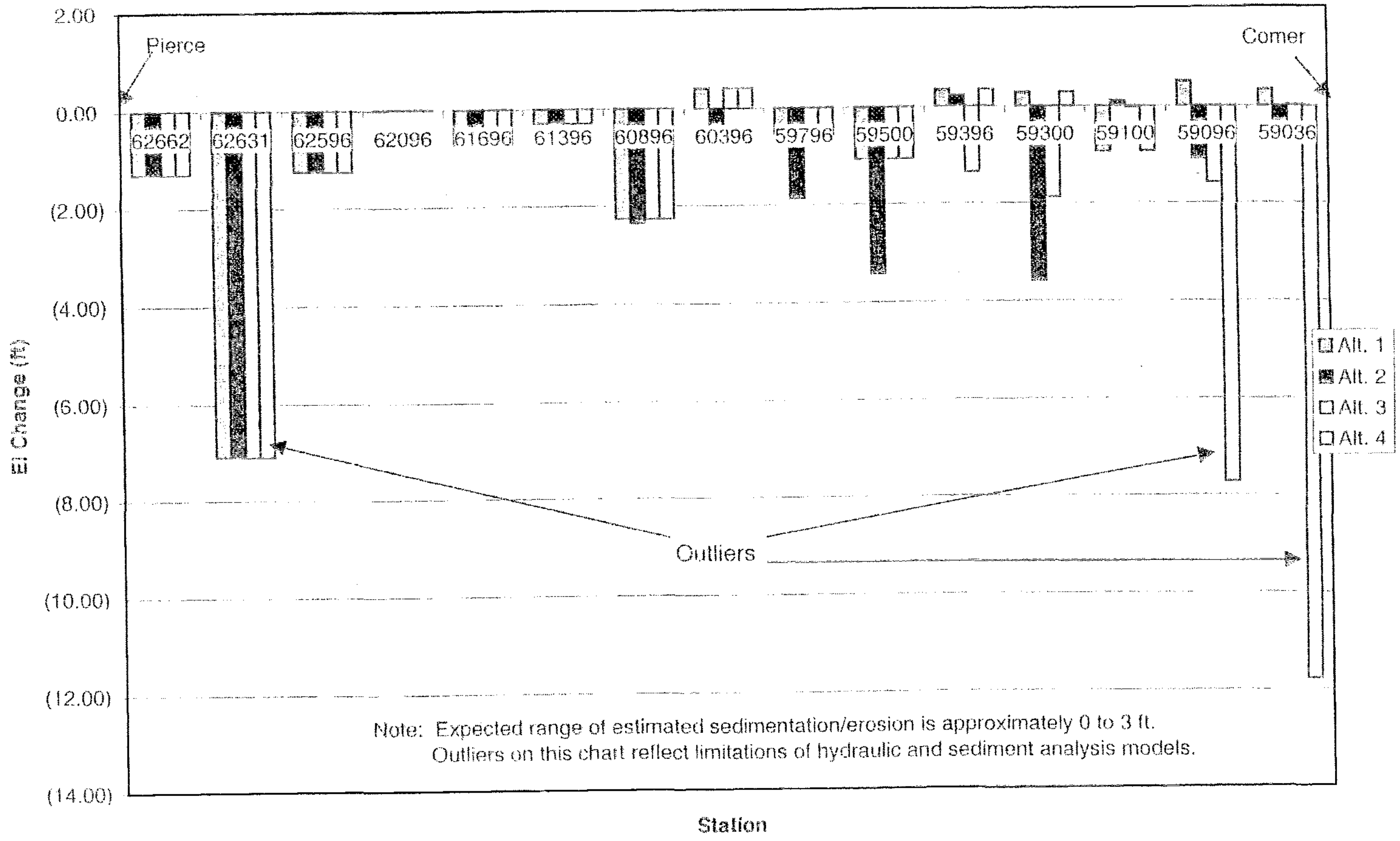
This alternative would provide an increase and improvement in available aquatic and terrestrial habitat in the area of the former Comer Debris Basin. The implementation of alternative 4 would result in the creation of 300 to 400 feet of shaded riverine aquatic (SRA) habitat along the restored stream channel in the location of the former debris basin. Also, it would provide for additional terrestrial habitat through the addition of approximately ½ acre of native upland vegetation.

Construction required for alternative 4 would cause short-term disruption of existing habitat. Disturbance would extend upstream of the Comer Drive bridge approximately 50 feet only. The upper portion of the dam would be removed. Pools of standing water would no longer be formed, which might reduce existing aquatic habitat. However, new SRA habitat will increase habitat opportunities for western pond turtle and other sensitive species after basin modification.

Costs

Capital cost for alternative 4 is $590,000; however, existing operation & maintenance activities would be continue. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, and sediment removal. Annual cost is approximately $ 14,500.

FIGURE 4.14
Estimated Sedimentation/Erosion - Pierce to Comer
(Sediment Supply 9,000 tons over 35 days)



Note: Expected range of estimated sedimentation/erosion is approximately 0 to 3 ft.
Outliers on this chart reflect limitations of hydraulic and sediment analysis models.

FIGURE 4.15
Estimated Sedimentation/Erosion - Comer to Wardell
(Sediment Supply 9,000 tons over 35 days)

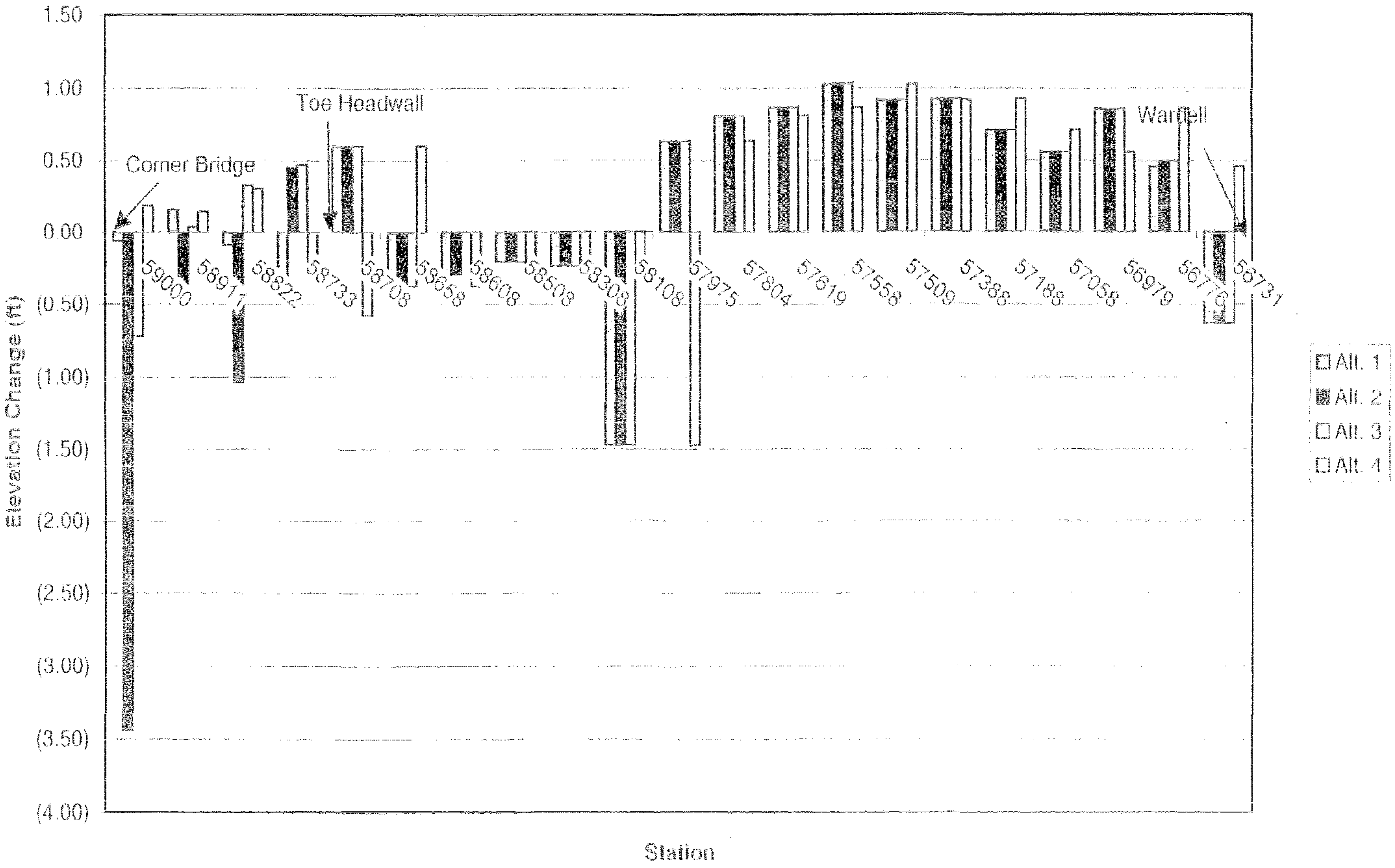
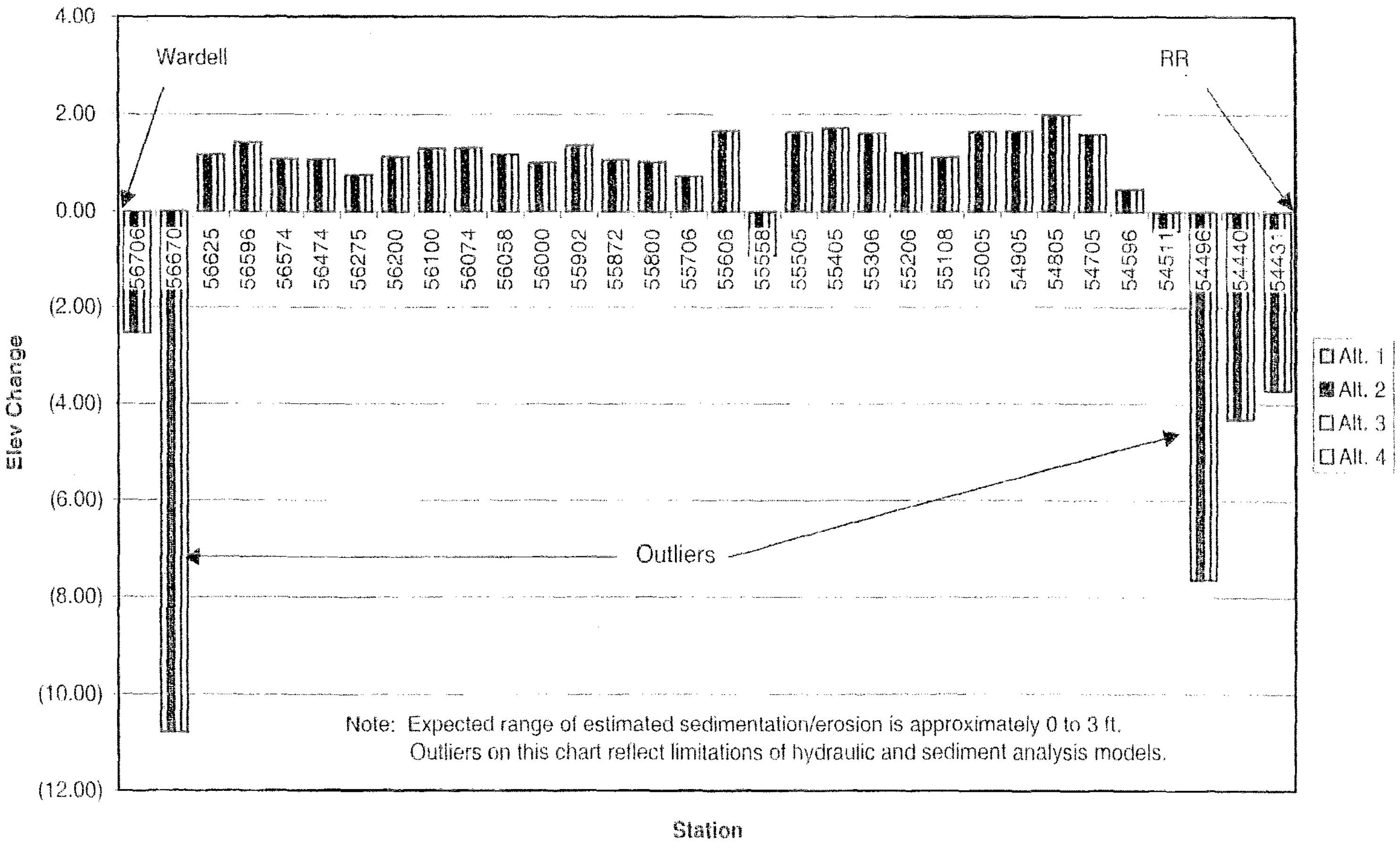


FIGURE 4.16
Estimated Sedimentation/Erosion - Wardell to Railroad
(Sediment Supply 9,000 tons over 35 days)



Note: Expected range of estimated sedimentation/erosion is approximately 0 to 3 ft.
Outliers on this chart reflect limitations of hydraulic and sediment analysis models.

TABLE 4.1
Summary of 100 Year Storm Event Results
Comer Debris Basin Engineering Pre-Planning Study

Bridge	Bridge Deck Elevation[1]		Modeled[2] Water Surface El. (100 year)				Flood Depth (ft)
	Lowest	Highest	Alt. 1	Alt. 2	Alt. 3	Alt. 4	
Pierce Road	425	429	420.52	420.52	420.52	420.52	
Comer Drive	371.4	372.5	**372.95**	364.29	364.29	369.33	0.45
Wardell Road	344	348	339.38	339.38	339.38	339.38	
Railroad	317.6	319.5	**322.02**	**322.02**	**322.02**	**322.02**	2.52

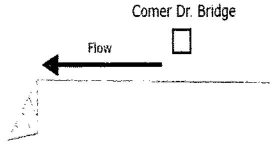
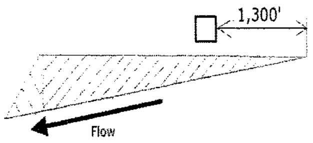
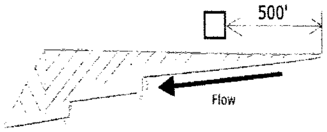
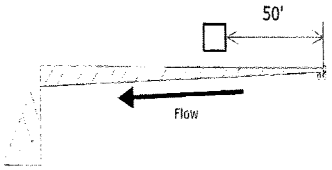
Notes

1) Elevations are reported in feet and are based on NGVD 1927.

2) Modeled water surface elevations taken from HEC-RAS model run for study reach with Q = 1,180 cfs.

3) **Boldface** indicates modeled water surface elevation overtops the highest bridge deck elevation.

TABLE 4.2
Comparative Summary of Alternatives
Comer Debris Basin Engineering Feasibility Study

Criteria	**Alternative 1: Existing Conditions**  	**Alternative 2: Remove Headwall, Grade Uniform, Equilibrium Slope**  	**Alternative 3: Remove Headwall, Construct Steps in Channel for Pools**  	**Alternative 4: Partial Headwall Removal, Limited Excavation** 
Preliminary Project Cost	No additional cost to District	$1,250,000	$890,000	$590,000
Construction		$1,000,000	$640,000	$340,000
Planning/Permitting		$100,000	$100,000	$100,000
Pre Design/Design/Oversight		$150,000	$150,000	$150,000
Annual O & M		$14,500	$20,000	$14,500
Physical				
General Description	Current conditions. 12-foot concrete dam with retaining walls. Basin filled with sediment 300 ft x 150 ft. Approx 4-foot clearance at Comer.	Remove concrete structure, excavate existing sediment to width of upstream channel, establish uniform slope, stabilize remaining sediment.	Remove concrete structure, excavate existing sediment to width of upstream channel, establish steps in slope, stabilize remaining sediment.	Remove upper 3' of concrete structure, excavate existing sediment to depth of 3' to width of upstream channel, stabilize remaining sediment.
Flooding	Overtopping at Comer Drive bridge is potential public safety risk.	Removes flood risk at Comer Drive bridge.	Removes flood risk at Comer Drive bridge.	Removes flood risk at Comer Drive bridge.
Sedimentation/Erosion	Dam construction in 1973/74 trapped sediment and resulted in downcutting of downstream channel bed. Currently, downstream section appears to be accumulating sediment.	No change in sediment flow caused by this alternative.	No change in sediment flow caused by this alternative.	No change in sediment flow caused by this alternative.
Maintenance	No maintenance since 1992.	Restored channel and revegetated areas require periodic maintenance inspection.	Restored channel and revegetated areas require periodic maintenance inspection.	Restored channel and revegetated areas require periodic maintenance inspection.
Environmental/Biological				
Aquatic	Pools at base of dam with chorus frog tadpoles. No red-legged frog or western pond turtle habitat.	Creates 300 to 400 feet of SRA habitat. Pools no longer formed, reducing existing aquatic habitat. New SRA may increase habitat opportunities for western pond turtle or other sensitive species.	Creates 300 to 400 feet of SRA habitat. Pools formed during wet months; expected to remain some time into dry months. Habitat opportunities better for aquatic species than Alternatives 2 and 4.	Creates 300 to 400 feet of SRA habitat. Pools no longer formed, reducing existing aquatic habitat. New SRA may increase habitat opportunities for western pond turtle or other sensitives species.
Terrestrial	Evidence of deer, Cooper's Hawk. Debris basin area is open, with little cover for habitat.	Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added.	Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added.	Formation of SRA provides additional ground cover and foraging opportunities. Approx. 0.5 acre of native upland vegetation added.
Public Interest				
Aesthetics	Presence of debris basin dam limits aesthetics of stream.	Formation of SRA in restored channel will integrate existing SRA habitat upstream and downstream of the debris basin.	In addition to increasing SRA through the former debris basin, addition of pools and small falls offer improved aesthetics over Alternatives 1, 2, and 4.	Remaining 9 vertical feet of dam headwall reduce aesthetic appeal of this alternative.
Access	Limited. Basin dam forms obstruction to easy use of this part of the creek.	Same as existing.	Same as existing.	Same as existing.
Community Involvement	None known at this time.	Opportunity for community to participate in and observe stream restoration effort.	Opportunity for community to participate in and observe stream restoration effort.	Opportunity for community to participate in and observe stream restoration effort.

Attachment A

Conceptual Alternative Flood Protection Elements

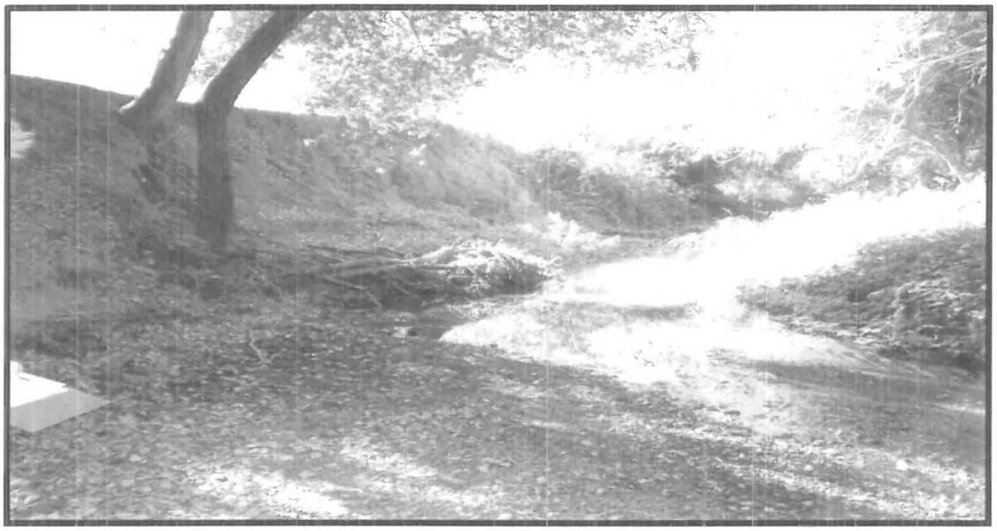
Introduction:

This attachment describes the conceptual alternative elements (E1 through E13) for the Calabazas Creek project in detail. Each element is briefly described, the existing site conditions are defined, all the structural facilities are described, land requirements are identified, construction techniques are described, and cost estimate is provided.

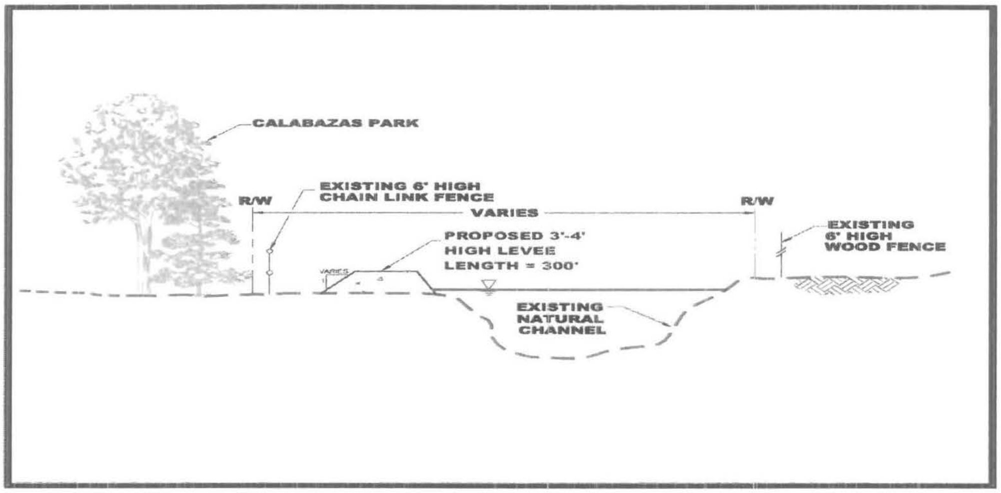
There are thirteen conceptual alternative elements for Calabazas Creek Miller Avenue to Comer Drive:

Element #1

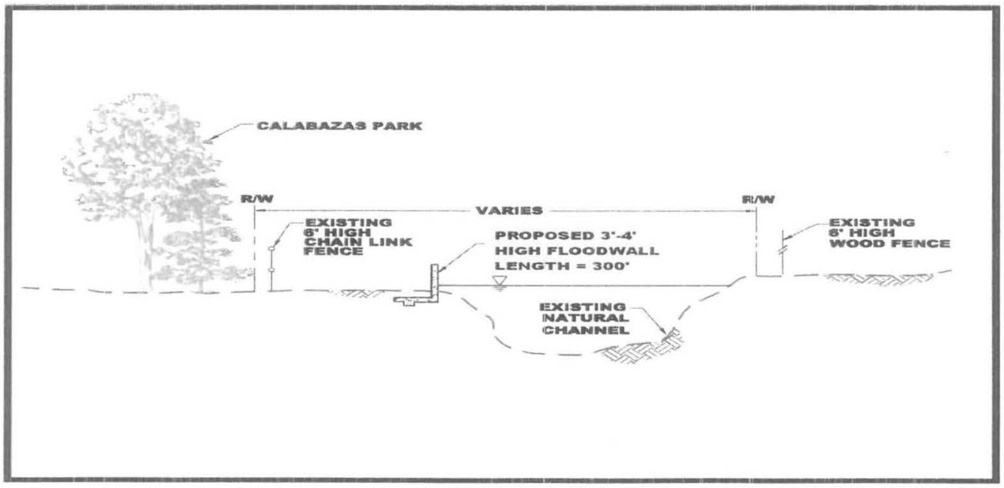
Levee/floodwall at Calabazas Park



Looking upstream at Calabazas Park


CALABAZAS PARK
R/W
EXISTING 6' HIGH CHAIN LINK FENCE
VARIES
R/W
EXISTING 6' HIGH WOOD FENCE
PROPOSED 3'-4' HIGH LEVEE LENGTH = 300'
VARIES
EXISTING NATURAL CHANNEL

Looking upstream


CALABAZAS PARK
R/W
VARIES
R/W
EXISTING 6' HIGH CHAIN LINK FENCE
PROPOSED 3'-4' HIGH FLOODWALL LENGTH = 300'
EXISTING 6' HIGH WOOD FENCE
EXISTING NATURAL CHANNEL

Looking upstream

E1: Levee/Floodwall at Calabazas Park

A 400-foot channel section along Calabazas Park between Blaney Avenue and Rainbow Drive (approx. sta 485+80 to sta 489+73) would be modified by either the construction of an earthen levee, or alternatively, placement of a floodwall 3 to 4 feet in height along the top of the existing east bank.

This length of creek is currently a natural trapezoidal earthen channel. The east side (Calabazas Park) of the creek will flood during a 1% flood event. To prevent the channel from flooding at this location, either a levee could be built or a floodwall installed on top of the existing east bank. The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

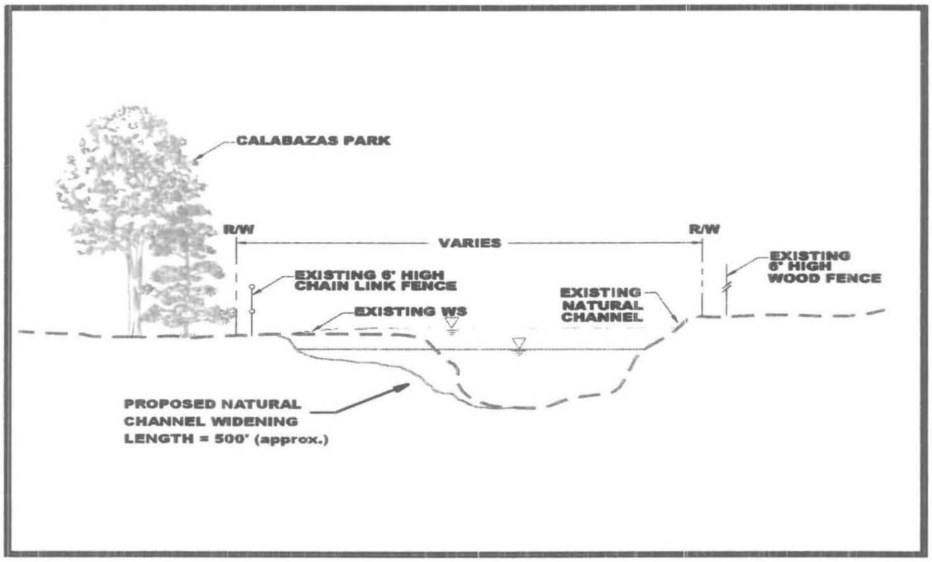
Construction of "Element 1" will benefit Calabazas Park and the adjacent areas including the YMCA and library. Concerns associated with E1 include a slight reduction in space along Calabazas Park, the temporary loss or relocation of trees, as well as noise and dust impact during construction.

Existing O&M activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element #2

Widen channel

Looking
upstream
at
Calabazas
Park


CALABAZAS PARK
R/W
VARIES
R/W
EXISTING 6' HIGH CHAIN LINK FENCE
EXISTING WS
EXISTING NATURAL CHANNEL
EXISTING 6' HIGH WOOD FENCE
PROPOSED NATURAL CHANNEL WIDENING LENGTH = 500' (approx.)

Looking
upstream

Channel is widened with
a sensitivity to the natural creek
features such as trees and rocks.

E2: Channel Widening at Calabazas Park

A 600-foot channel section along Calabazas Park between Blaney Avenue and Rainbow Drive (approx sta 483+80 to sta 489+73) would be enlarged.

Creek geometry at this location is currently a natural trapezoidal earthen channel. Flood waters will overtop the east bank and enter Calabazas Park and the adjoining neighborhood during high flow. During construction, the existing trapezoidal channel at the affected location would be excavated and rebuilt wider. Enlarging the existing channel would increase creek capacity sufficiently enough to contain the 1% design flow with the required freeboard.

Construction of "Element 2" will benefit Calabazas Park and the adjacent areas including the YMCA and library. Construction of this element will produce additional habitat for fish and wildlife as a result of channel widening. Concerns associated with E2 include a slight reduction in space along Calabazas Park, the temporary loss of trees, as well as noise and dust impact during construction.

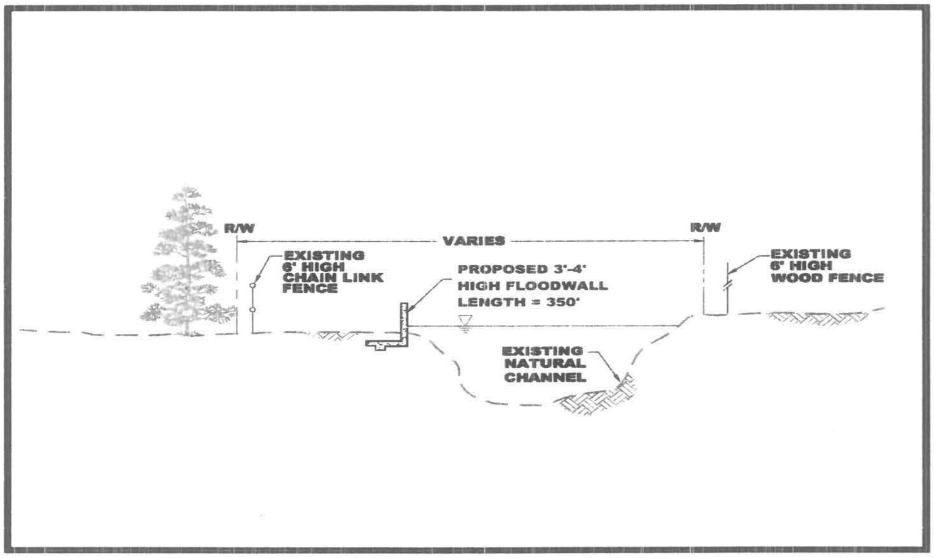
All construction would occur within existing right-of-ways. No new right-of-way or land acquisition would be needed. The Channel widening at Calabazas Park could be completed in one construction season (one summer).

Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element # 3

Construct floodwall

Looking
downstream
at footbridge


R/W
VARIES
R/W
EXISTING 6' HIGH CHAIN LINK FENCE
PROPOSED 3'-4' HIGH FLOODWALL LENGTH = 350'
EXISTING 6' HIGH WOOD FENCE
EXISTING NATURAL CHANNEL

Looking
upstream

Floodwall extends approximately 130' upstream and 220' downstream from existing footbridge.

E3: Floodwall u/s, d/s of the Footbridge

This element entails work near an existing footbridge currently located between Rainbow Drive and Highway 85, from approximate channel stations 501+36 to 501+42. This existing footbridge is currently located approximately 600 feet downstream of Highway 85. The footbridge connects the Cupertino Creekside Apartments on the north bank of the creek to the apartment pool on the south bank of the creek.

Beginning at a point 300-foot downstream and continuing 200-foot upstream of the footbridge, (approx. sta 498+36 to sta 503+35) the east bank would be modified by the addition of a 3 to 4-foot high floodwall.

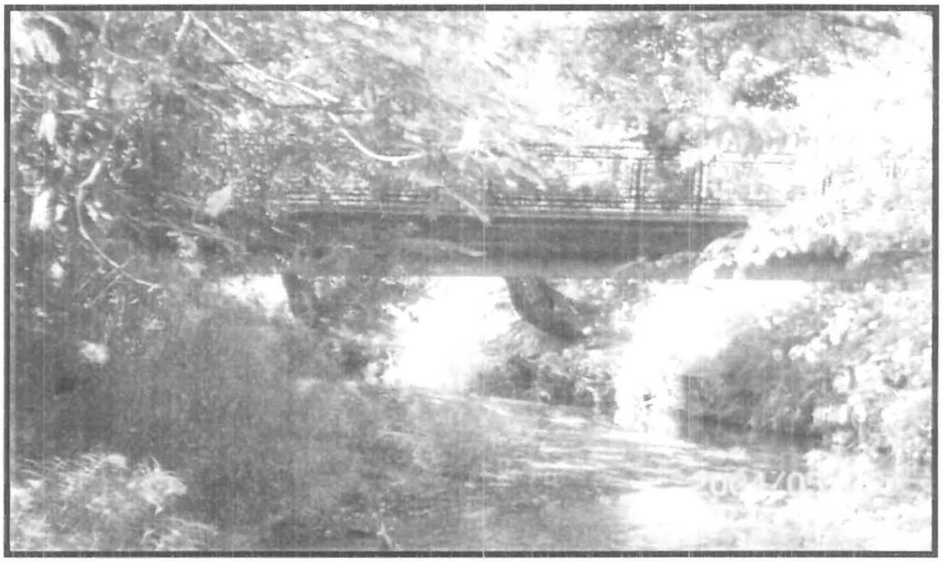
Creek geometry at this location is currently a natural trapezoidal earthen channel. The east side of the creek will flood during 1% flow. To prevent the channel from flooding at this location a floodwall would be installed on top of the existing east bank. The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Flooding on the east side would cause flooding of the Cuperino Creekside Apartment complex swimming pool and adjacent private homes on Calabazas Creek Circle. Construction of “Element 3” will benefit the adjacent property along Calabazas Creek Circle and the area between Hwy 85 and Rainbow Drive. Although floodwalls are not necessarily aesthetically pleasing, they are more appropriate than levees for this location due to space limitations. Temporary impacts of this element include the loss of trees, limited accessibility to the apartment swimming pool, and the noise and dust associated with construction activities.

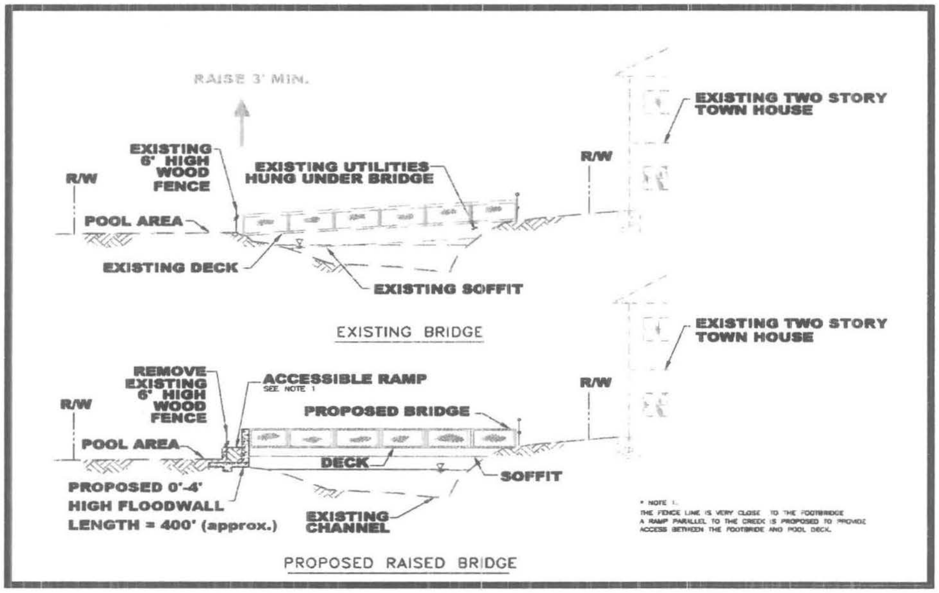
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element #4

Raise existing footbridge



Looking upstream at footbridge


RAISE 3' MIN.
EXISTING 6' HIGH WOOD FENCE
EXISTING UTILITIES HUNG UNDER BRIDGE
R/W
POOL AREA
EXISTING DECK
EXISTING SOFFIT
R/W
EXISTING TWO STORY TOWN HOUSE
REMOVE EXISTING 6' HIGH WOOD FENCE
ACCESSIBLE RAMP
SEE NOTE 1
PROPOSED BRIDGE
R/W
POOL AREA
DECK
SOFFIT
PROPOSED 0'-4' HIGH FLOODWALL LENGTH = 400' (approx.)
EXISTING CHANNEL
R/W
EXISTING TWO STORY TOWN HOUSE

EXISTING BRIDGE

PROPOSED RAISED BRIDGE

* NOTE 1.
THE FENCE LINE IS VERY CLOSE TO THE FOOTBRIDGE
A RAMP PARALLEL TO THE CREEK IS PROPOSED TO PROVIDE
ACCESS BETWEEN THE FOOTBRIDE AND POOL DECK.

Looking upstream

Floodwall extends approximately 150' upstream and 250' downstream of raised footbridge.

E4: Raise Existing Footbridge

This element entails work on and work near the existing footbridge. The current location of this existing footbridge is described above in the first paragraph of "E3".

The east side of the footbridge would be raised to the same elevation as the west bank. Easy access to the apartment complex pool would be maintained, while providing increased creek capacity.

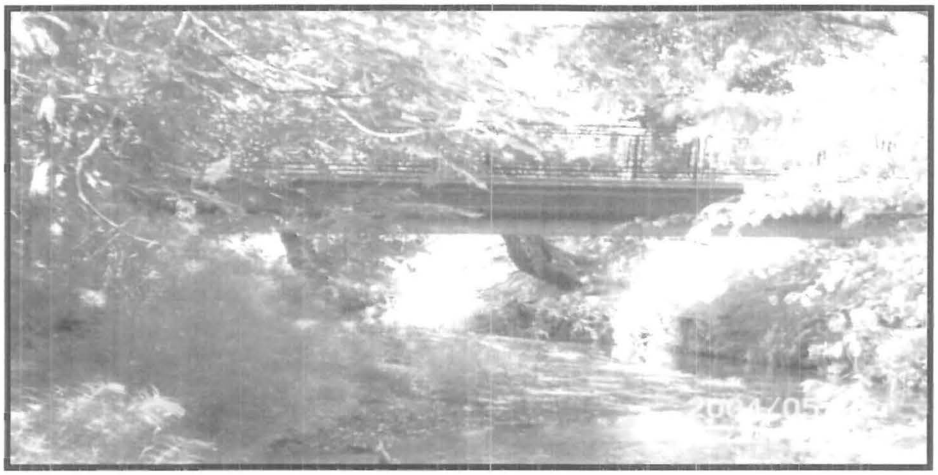
To prevent flooding upstream and downstream of the existing footbridge during high flow events, the footbridge would be rebuilt to a higher elevation on the east side of the channel. Currently, the low bridge height is an obstacle and impedance during high water flow. Raising this footbridge will increase the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Element 4" will benefit the adjacent property along Calabazas Circle and the area between Hwy 85 and Rainbow Drive. In addition to raising of the footbridge, "Element 4" also includes construction of a floodwall from a point 250 feet downstream of the footbridge to a point 150 feet upstream of the footbridge on the eastern (pool side) bank. Although floodwalls are not necessarily aesthetically pleasing, they are more appropriate than levees for this location due to space limitations. Temporary impacts of this element include the loss of trees, limited accessibility to the apartment swimming pool during construction, and the noise and dust associated with construction activities.

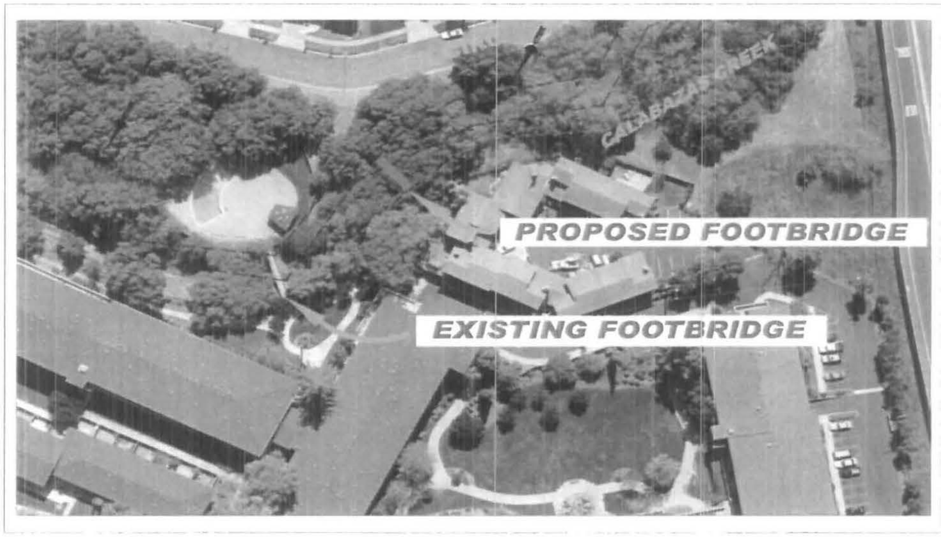
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element #5

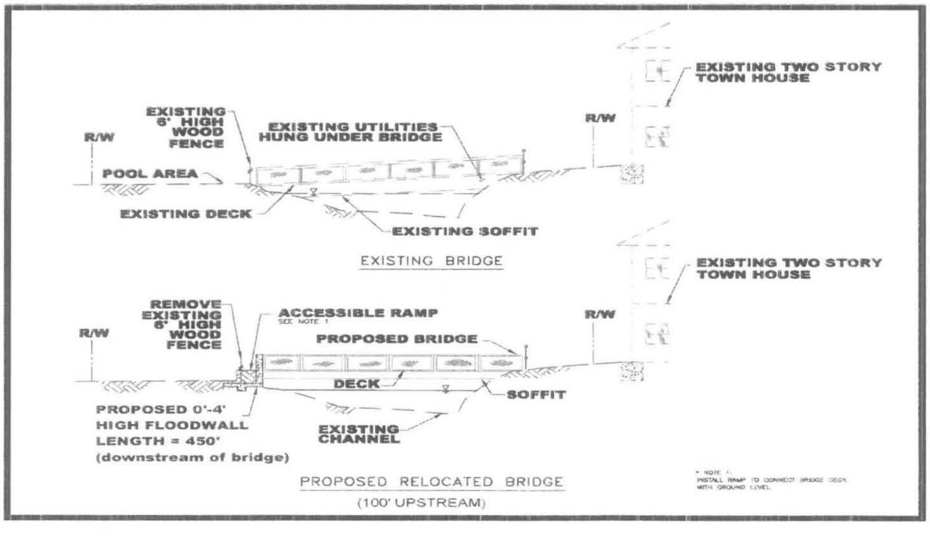
Relocate footbridge



Looking upstream at footbridge



Plan view aerial


EXISTING TWO STORY TOWN HOUSE
EXISTING 6' HIGH WOOD FENCE
EXISTING UTILITIES HUNG UNDER BRIDGE
R/W
R/W
POOL AREA
EXISTING DECK
EXISTING SOFFIT
EXISTING BRIDGE
EXISTING TWO STORY TOWN HOUSE
REMOVE EXISTING 6' HIGH WOOD FENCE
ACCESSIBLE RAMP
SEE NOTE 1
R/W
R/W
PROPOSED BRIDGE
DECK
SOFFIT
PROPOSED 0'-4' HIGH FLOODWALL LENGTH = 450' (downstream of bridge)
EXISTING CHANNEL
PROPOSED RELOCATED BRIDGE
(100' UPSTREAM)
* NOTE 1:
INSTALL RAMP TO CONNECT BRIDGE DECK WITH GROUND LEVEL

Looking upstream

E5: Footbridge Relocation

This element entails work on and work near the existing footbridge. The current location of this existing footbridge is described above in the first paragraph of "E3".

The footbridge would be removed and relocated approximately 100-feet upstream of the existing location. Relocation of the bridge would maintain access to the apartment complex pool located on the east side of the creek.

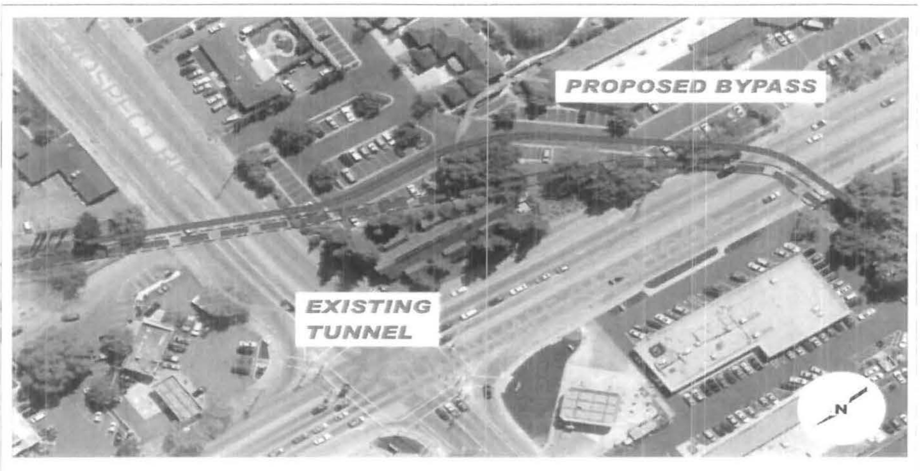
To prevent flooding upstream and downstream of the footbridge during high flow events, the bridge would be rebuilt at a higher elevation 100-feet upstream of the existing location. Relocation of the footbridge, and the accompanying raise in height, will increase the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Element 5" will benefit the adjacent property along Calabazas Creek Circle and the area between Highway 85 and Rainbow Drive. During the construction phase, use of the apartment swimming pool will be less convenient. There may also be a temporary loss of habitat due to clearing, and the associated noise and dust impacts.

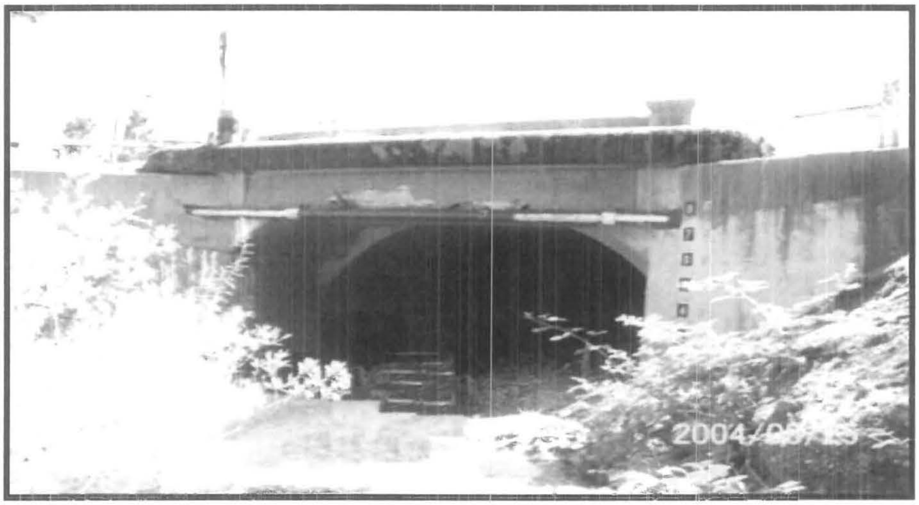
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element #6

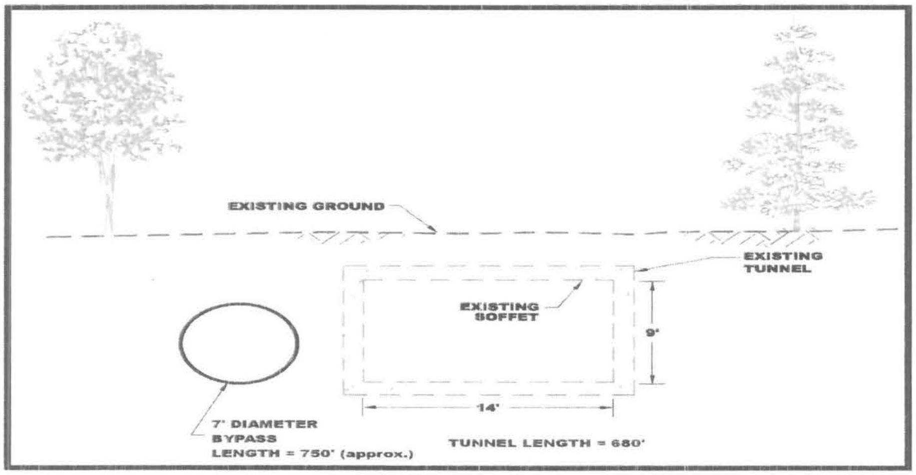
Construct bypass pipe



Plan view aerial



Upstream face of Saratoga-Sunnyvale tunnel



Looking upstream

E6: Saratoga-Sunnyvale Bypass Pipe

An underground bypass composed of a 7-foot diameter concrete circular pipe (approx. sta 525+11 to sta 531+94) would be constructed along the existing tunnel from Prospect Road to Saratoga-Sunnyvale Road.

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road) during high flow events, a bypass pipe would be constructed along the existing tunnel under the parking lot on the west side. Bypasses are appropriate where environmental features or access problems prevent enlargement or improvement of the existing undersized tunnel, undersized creek, or other undersized structure. The proposed bypass pipe will route excess flows around the problem area and reintroduce them to the channel further downstream. The underground 7 foot diameter bypass pipe would be constructed along the existing curved Saratoga-Sunnyvale tunnel under the parking lot. The bypass pipe would be approximately 750 feet long, with a capacity of 752 cfs (the difference between existing capacity and 1% design flow).

It is expected that the bypass would be constructed partly within existing utility and SCVWD easements. However, adequate SCVWD easements are not in place to allow the work in “Element 6”. This District will need to coordinate with the San Jose National Bank, the City of Saratoga and the City of San Jose to secure the necessary easements for this work.

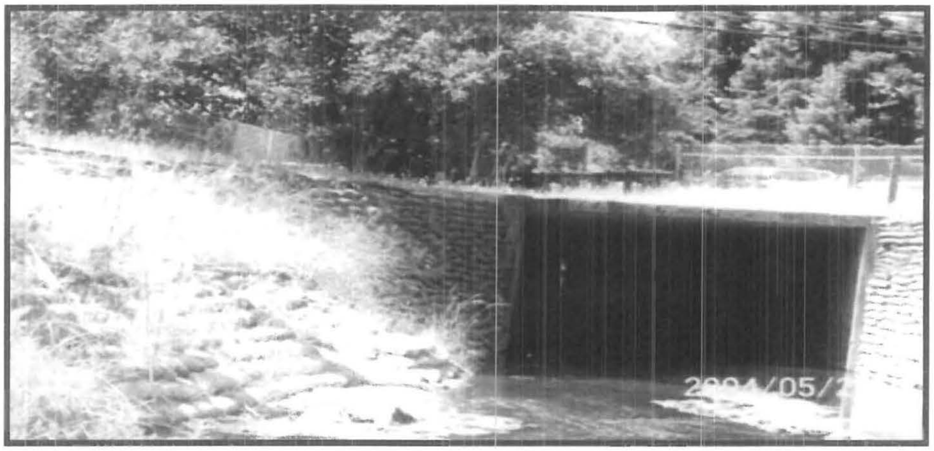
Once trenching and bypass pipe installation is complete, trenches would be backfilled and pre-construction road surface conditions would be restored. Some of the excavated materials would be exported from the site. Construction of the bypass pipe would be completed in sections to minimize road closures and traffic disruption. Construction and installation would be completed in one construction season (one summer) unless work on the existing utilities located beneath the affected roadways dictates a two construction season operation.

Construction of “Element 6” will benefit the business and residential areas upstream and southwest of Saratoga-Sunnyvale Road. It will also prevent inundation of the Prospect and Saratoga-Sunnyvale road intersection with flood waters, one of the major arteries in and out of Saratoga. Construction work will temporary impact traffic and possibly cause a temporary loss of parking places for local businesses. Existing trees may be impacted and the area will definitely experience temporary noise and dust impacts during construction.

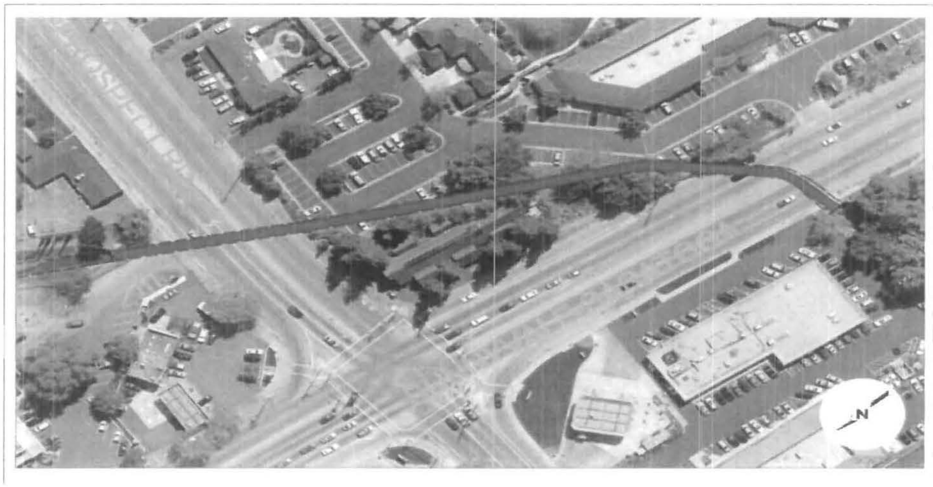
Operation and maintenance of the Saratoga-Sunnyvale bypass would be minimal. Although the Saratoga-Sunnyvale bypass would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

Element #7

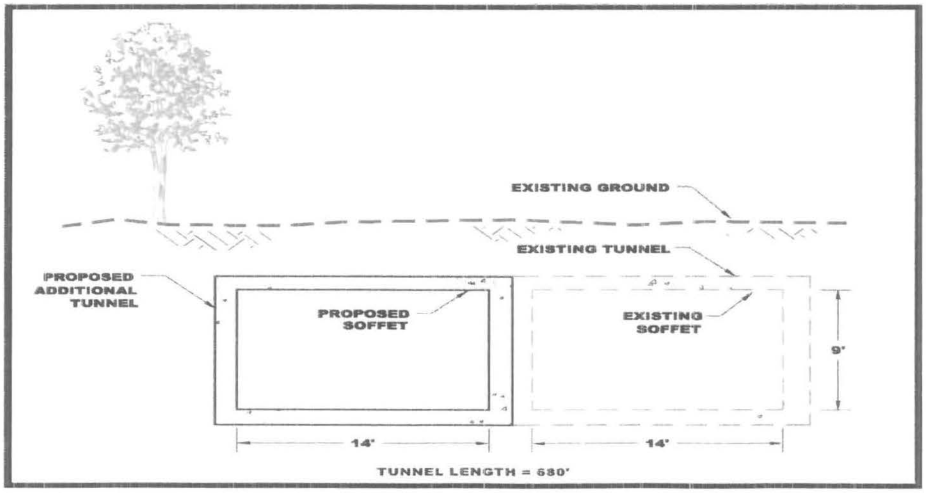
Additional tunnel



Looking upstream towards Prospect Road tunnel



Plan view aerial



Looking upstream towards Prospect Road

E7: Saratoga-Sunnyvale Additional Tunnel

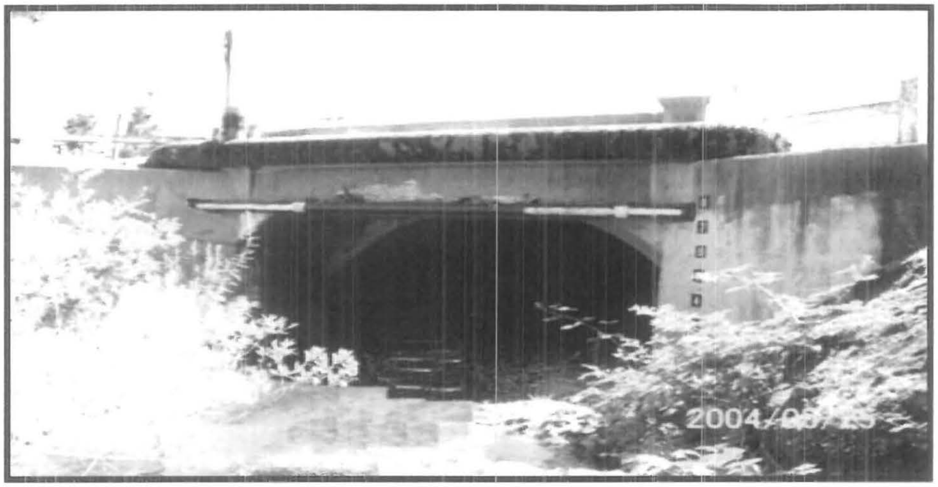
A 9-foot by 14-foot underground concrete tunnel would be constructed along the left side (looking upstream) of the existing 9-foot by 14 foot underground concrete tunnel with a length of approximately 680 feet from Prospect Road to Saratoga-Sunnyvale Road (approx. sta 525+11 to sta 531+94).

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road) during high flow events, this additional tunnel would be constructed along the west side of the existing tunnel. Additional tunnels are appropriate where the 1% flood design flow significantly exceeds the flow capacity of the existing tunnel. This second tunnel proposed for "Element 7" will route excess flows parallel to the existing undersized tunnel. The additional tunnel would be approximately the same length and the same cross sectional size as the existing 680-feet tunnel and will carry half of the 1% design flow. The existing tunnel traverses the San Jose National Bank property in a curved alignment. Pedestrian access to the existing underground tunnel is difficult, but possible from both the downstream end at Prospect Road and upstream end at Saratoga-Sunnyvale Road.

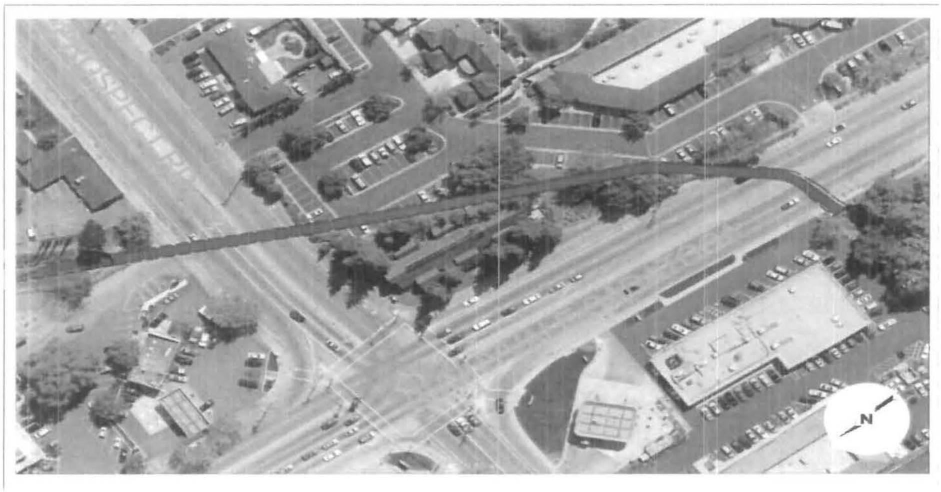
Construction of "Element 7" will benefit the business and residential areas upstream and southwest of Saratoga-Sunnyvale Road. It will also prevent inundation of one of the major arteries in and out of Saratoga, the Prospect and Saratoga-Sunnyvale road intersection, with flood waters. Construction work will temporary impact traffic and possibly cause a temporary loss of parking places for local businesses. Existing trees may be impacted and the area will definitely experience temporary noise and dust impacts during construction.

Operation and maintenance of the Saratoga-Sunnyvale additional tunnel would be minimal. Although the Saratoga-Sunnyvale additional tunnel would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

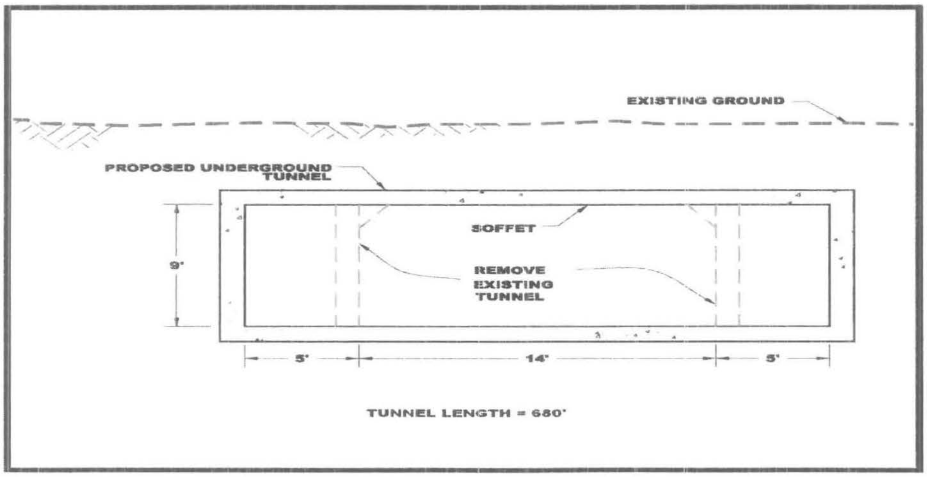
Element #8
Replace tunnel



Upstream
face of
Saratoga –
Sunnyvale
Road tunnel



Plan
view
aerial



Looking
upstream

E8: Saratoga-Sunnyvale Tunnel Replacement

The existing 9-foot by 14-foot underground concrete tunnel would be replaced for a length of approximately 680 feet (approx. sta 525+11 to sta 531+94) from the Prospect Road outlet to the inlet at Saratoga-Sunnyvale Road. The old tunnel would be demolished and replaced by a new 9 by 24-foot underground tunnel.

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road) during high flow events, the underground tunnel between Prospect Road and Saratoga-Sunnyvale Road would be enlarged to the extent necessary to pass the 1% flow. The enlarged tunnel would be approximately the same length as the existing 680-foot, but able to carry the 1% design flow. The existing tunnel traverses the San Jose National Bank property in a curved alignment. Pedestrian access to the existing underground tunnel is difficult, but possible from both the downstream end at Prospect Road and upstream end at Saratoga-Sunnyvale Road.

The construction work would be done within District easements. The existing tunnel would be demolished and reconstructed. The open-cut sections would be done by trenching with shoring. Trenching would be backfilled and pre-construction surface conditions would be restored. Construction is expected to last 2 to 4 years.

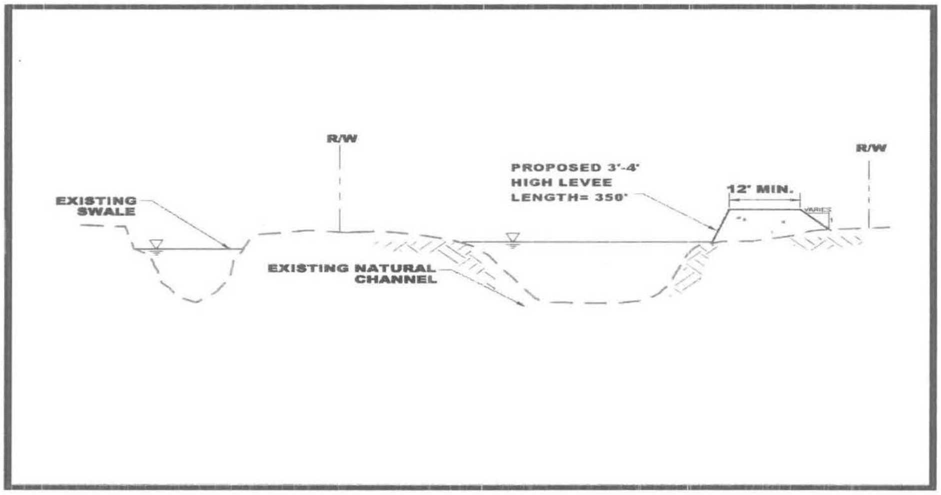
Construction of “Element 8” will benefit the business and residential areas upstream of the tunnel. It might cause temporary traffic impacts and possible temporary loss of parking for local businesses, potential impact to existing trees, and temporary noise and dust impacts during construction.

Operation and maintenance of the Saratoga-Sunnyvale extended tunnel would be minimal. Although the proposed Saratoga-Sunnyvale widened tunnel would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

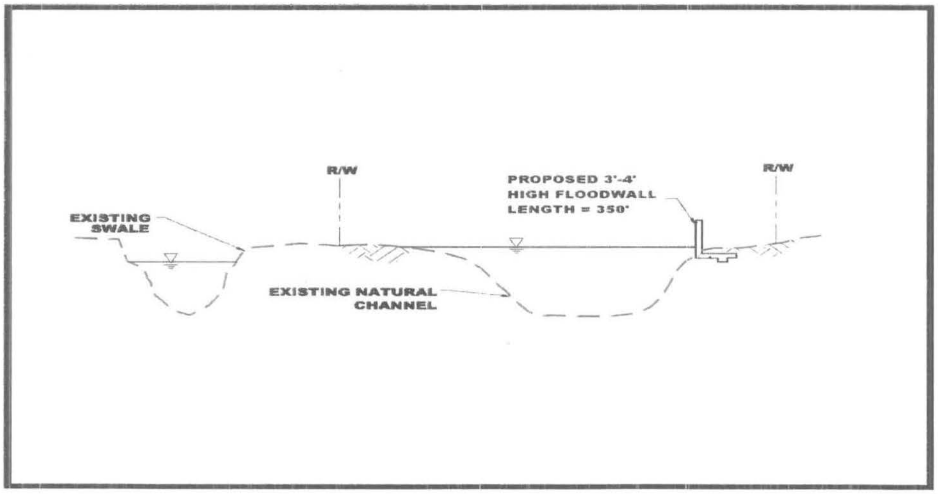
Element #9

Construct levee/floodwall

Looking upstream, Saratoga-Sunnyvale Road tunnel



Looking upstream



Looking upstream

E9: Levee/Floodwall u/s Saratoga-Sunnyvale Road

This element involves the construction of a levee or floodwall 3 to 4 feet in height on the west bank upstream of the Saratoga-Sunnyvale Road underground tunnel (approx. sta 531+94 to sta 534+91).

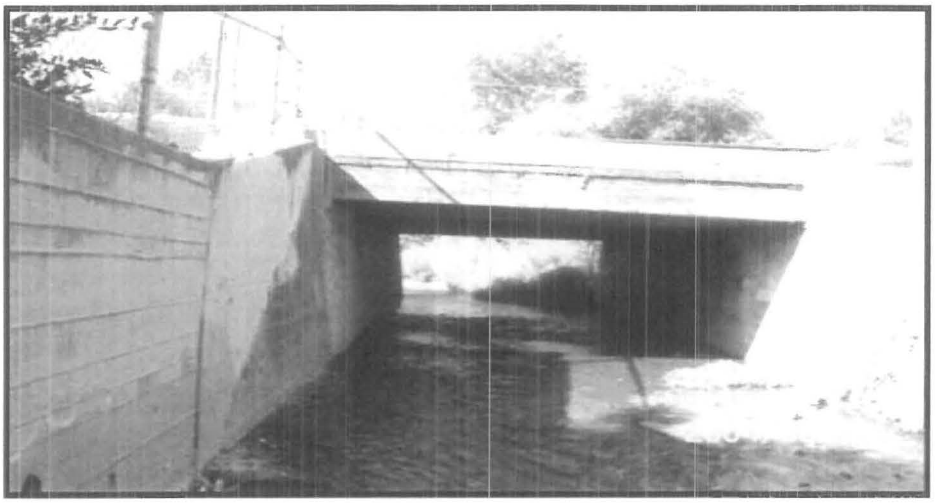
Creek geometry at this location is currently a natural trapezoidal earthen channel. The west side of the creek will flood during a 1% flow event. Mitigation can be accomplished by the 3-4 foot addition of either an earthen levee or flood wall on the existing west (northern) bank. The increase in the height of the channel will improve the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Element 9" will protect the Coldwell Banker Blue Hills parking lot from flooding. Construction will also have temporary traffic impacts and possible temporary loss of parking for local businesses, potential impact to existing trees, as well as temporary noise and dust impacts during construction.

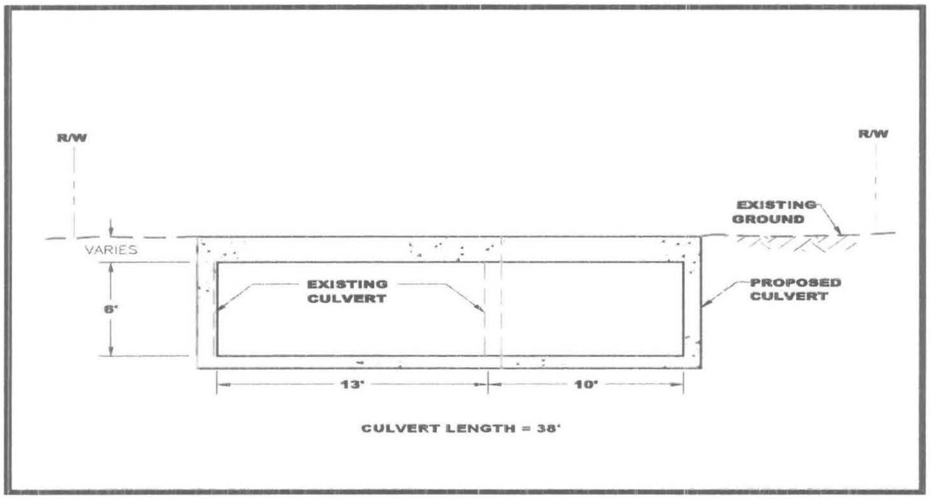
Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Element #10

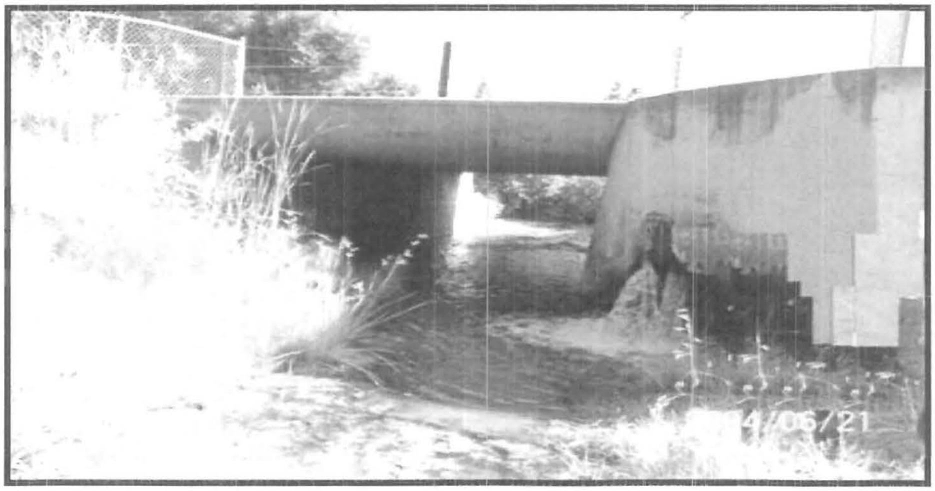
Replace culvert



Downstream face of Union Pacific Railroad culvert



Looking upstream



Upstream face of Union Pacific Railroad culvert

E10: Union Pacific Railroad (UPRR) Culvert Replacement

The existing 6 by 13-foot concrete box culvert would be demolished and replaced by a new 6 by 23-foot culvert (approx. sta 548+28 to sta 548+63).

To prevent flooding upstream of the UPRR culvert during high flow events, the existing culvert would be extended 10-feet in width, the calculated enlargement necessary to pass the 1% design flow. Although the existing 38 foot long UPRR culvert varies in width from 14.5 foot on the upstream face to 11.5 foot at the downstream face, the new culvert will be symmetrical along its length. The runs used to model the hydraulic behavior through the culvert are based on this variance in cross sectional width.

A large swale approximately 1350-feet long and 65 feet in width runs parallel to the Calabazas Creek from Saratoga-Sunnyvale Road to downstream of the UPRR on the east side of the creek.

The construction work would be done within District and Caltrans easements. The existing culvert would be demolished and reconstructed. Construction is expected to last 2 to 4 years.

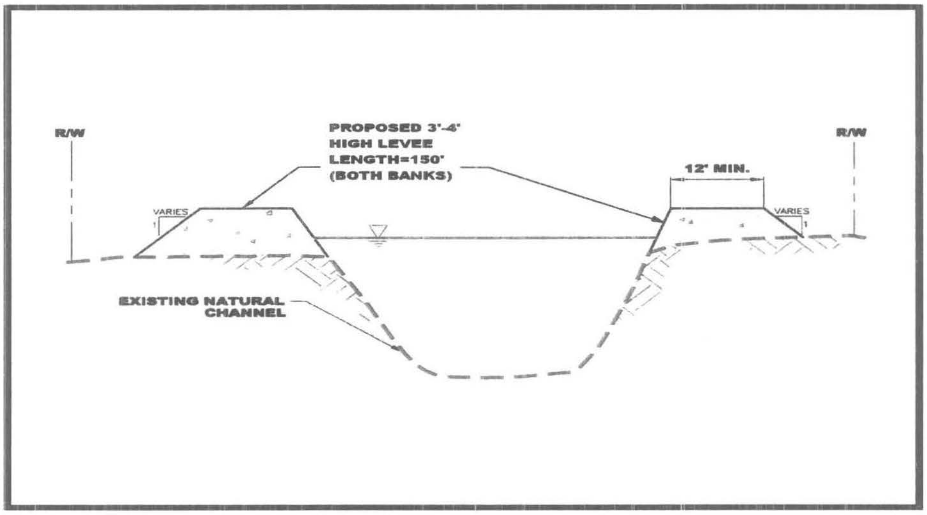
Construction of “Element 10” will benefit the Railroad and residents upstream of the Union Pacific Railroad culvert. Construction work will temporary impact railway traffic, and include the expected noise and dust impacts during construction. Time and expense for coordination with the Railroad would be of concern.

Operation and maintenance activities for the expanded UPRR culvert would be similar to existing culverts. The culvert would be designed to have adequate slope for sediment passage.

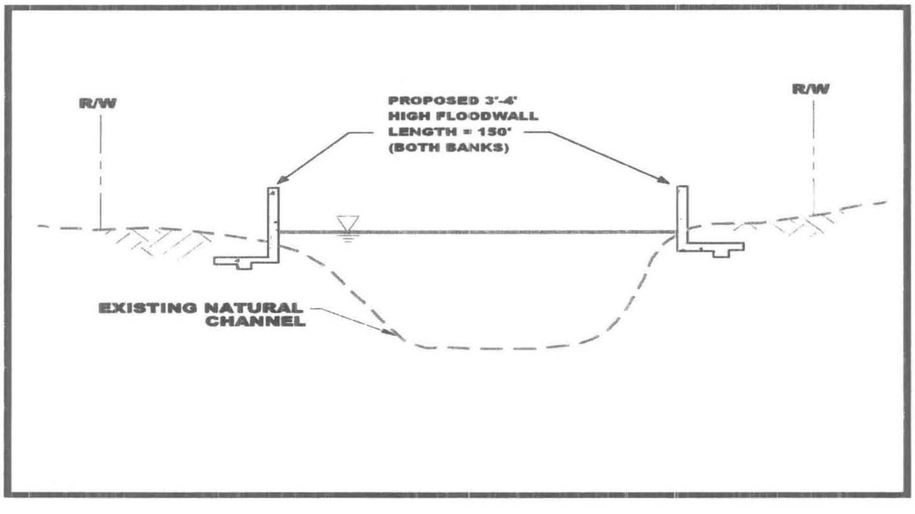
Element #11

Levees/floodwalls

Looking
upstream
of UPRR



Looking
upstream



Looking
upstream

E11: Levee/Floodwall u/s Union Pacific Railroad (UPRR)

Either levees or floodwalls or a combination of both would be built on both banks upstream of UPRR (approx. sta 549+05 to sta 549+80).

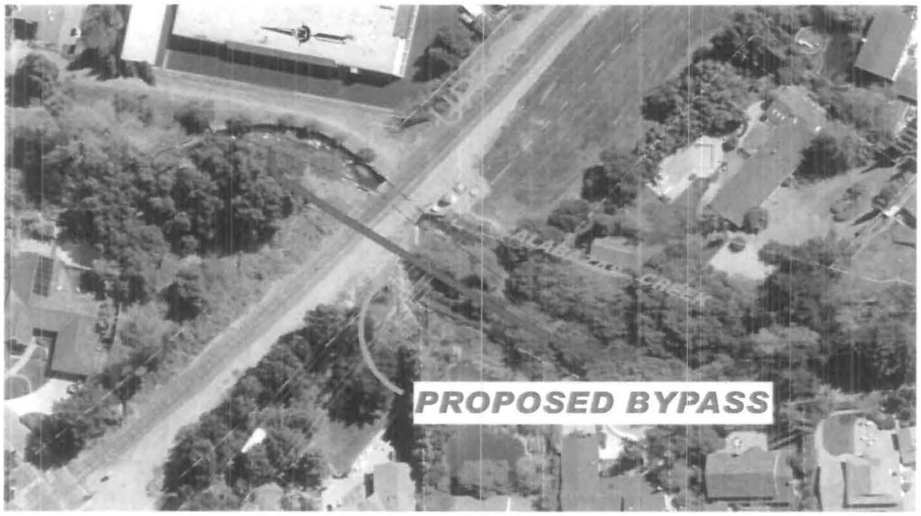
Creek geometry along this section can be described as a natural trapezoidal earthen channel. Implementation of "Element 11" would eliminate flooding u/s of UPRR through containment of the 1% design flow. To prevent the channel from flooding at this location, either levees or floodwalls of approximately 3-4 foot in height would be installed along the top of both sides of the channel (east and west banks). The increase in channel height will enlarge the conveyance capacity of the channel sufficiently enough to contain the 1% flow with the required freeboard.

Construction of "Element 11" will benefit the residents upstream of the Union Pacific Railroad culvert. Floodwall construction would occur within existing right-of-way, but levee construction might result in right-of-way impact. Existing trees may be impacted and the area will definitely experience temporary noise and dust impacts during construction.

Existing operation and maintenance activities are expected to continue within the project limits and no additional maintenance activities would be required. Typical maintenance activities include trash and debris removal, graffiti removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

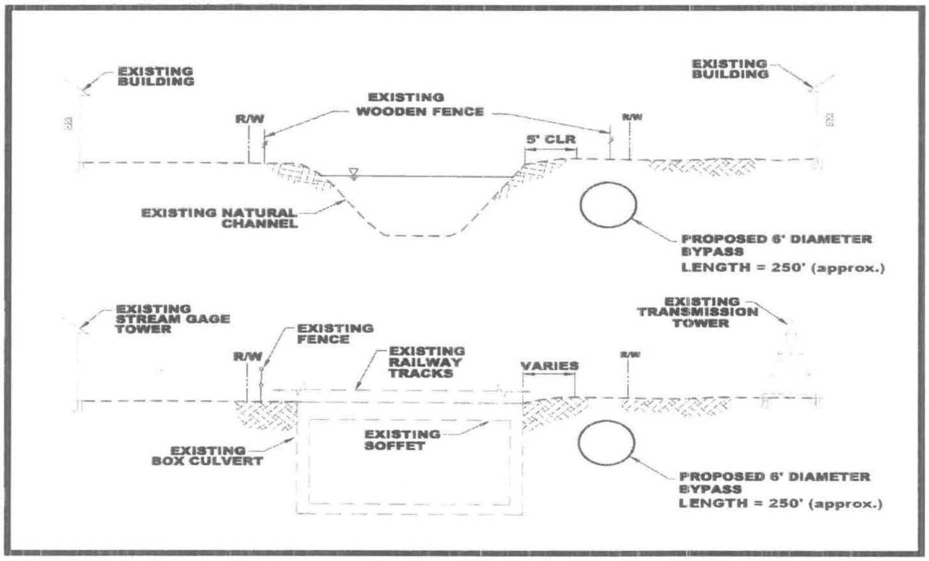
Element #12

Construct bypass pipe



Plan view aerial

Looking upstream at UPRR



Looking upstream

E12: Union Pacific Railroad (UPRR) Bypass Pipe

An underground bypass provided by a 6-foot diameter concrete circular pipe (approx. sta 547+68 to sta 549+80) would be constructed along the creek bank.

To prevent flooding upstream of the UPRR culvert during high flow events, a bypass would be constructed along the creek bank from upstream of UPRR to the residential area downstream. Bypasses are appropriate where environmental features or access problems prevent enlargement or improvement of the existing tunnel, creek, or other structure, which would allow it to contain the design flow. The proposed bypass pipe will route excess flows around the problem area and reintroduce them to the channel further downstream. The bypass pipe would be approximately 250 feet long and able to carry 620 cfs (the difference between existing capacity and 1% design flow).

It is expected that the bypass would be constructed within Caltrans, SCVWD, and resident easements. Construction and installation would be completed in 2-4 years depending on difficulties with Railroad Company and possible land acquisition from residents.

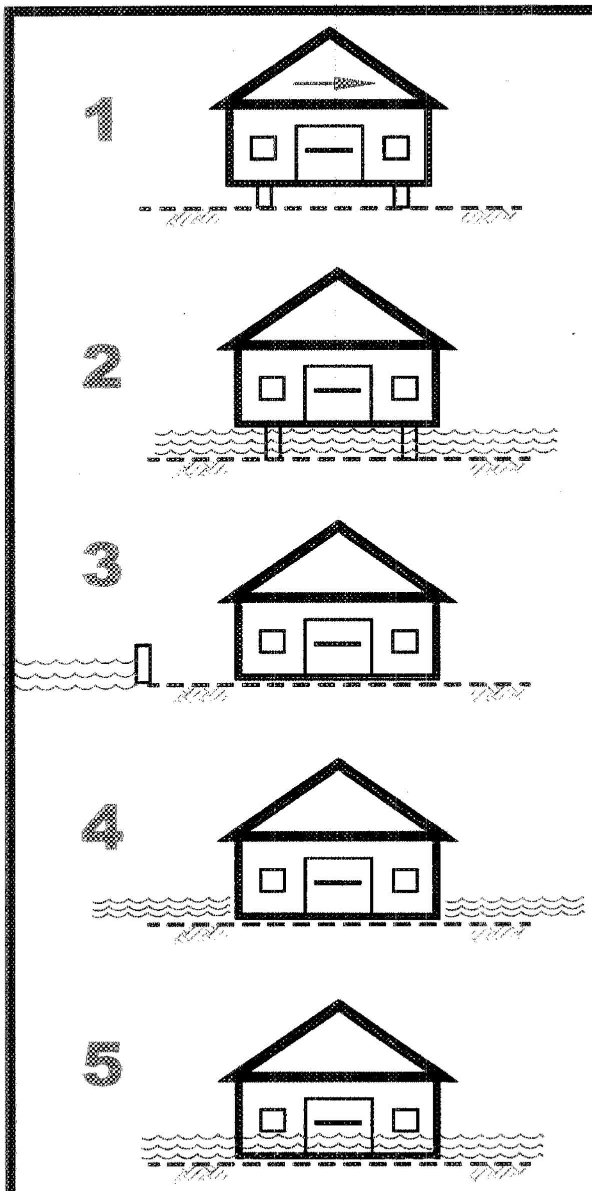
Construction of "Element 12" will benefit the Railroad and residents upstream of UPRR culvert. Construction work will temporary impact Railroad operation, will have right-of way impact, and will definitely result in temporary noise and dust impacts during construction. Construction is expected to last 2 to 4 years.

Operation and maintenance of the UPRR bypass would be minimal. Although the proposed UPRR bypass would be designed with adequate slope to move debris, the inlets would require regular cleaning to remove leaves and other debris during the flow season.

Element #13

Floodproofing

1. Relocate building
2. Elevate building
3. Build floodwalls around houses
4. Dry floodproofing
5. Wet floodproofing



Relocation:
Moving a building to high ground, above flood level

Elevation:
Raising a building so that flood water will go under it

Floodwalls:
Building a wall to keep flood water from reaching a building

Dry floodproofing:
Making the walls of the building and the openings watertight

Wet floodproofing:
Altering a building to minimize damage when flood waters enter

Examples of flood proofing
NOT TO SCALE

E13: Non-Structural (Flood Proofing)

Non–Structural flood mitigation includes 5 options for flood-proofing homes within the project area. Each structure in the floodplain would either be relocated, raised, have floodwalls built, and/or be protected by wet or dry flood proofing.

- Affected structures would be moved to a higher ground level above flood level.
- Affected structures would be raised 3 feet above the adjacent street level by extending the existing foundation. Actual height would vary throughout the affected area.
- Floodwalls of approximately 4 feet in height would be constructed around the perimeter of affected properties. Openings would be left in the floodwalls where driveways and other access routes to properties are located. The use of floodwalls would require active participation of property owners during periods of potential flooding. Partitions would need to be placed into openings around the perimeter of the floodwalls for the floodwalls to be effective.
- Walls of the affected building and their opening would be made watertight.
- Affected buildings would be altered to minimize damage when flood waters enter

Construction work would need to be coordinated with property owners. Maintenance easements would be needed for all parcels receiving work. Improvement would be done on a voluntary basis, at the property owner's request.

Attachment B

Conceptual Flood Protection Alternative Elements
Cost Analysis

Calabazas Creek Planning Study
Flood Protection Alternatives Summary Table

March - 2006

ELEMENTS (E)	CONCEPTUAL FLOOD PROTECTION ALTERNATIVES						
	A	B	C	D	E	F	G
E1: Construct Levee / Floodwall at Calabazas Park					$31,144 $150,410		
E2: Widen Channel at Calabazas Park		$131,066	$131,066	$131,066		$131,066	
E3: Contruct Levee / Floodwall upstream, downstream of Foot Bridge		$108,970 / $188,012	$108,970 / $188,012	$108,970 / $188,012	$108,970 / $188,012	$108,970 / $188,012	
E4: Raise Existing Foot Bridge		$282,208					
E5: Relocate Foot Bridge			$282,207	$282,207	$282,207	$282,207	
E6: Construct a Bypass Pipe along Saratoga-Sunnyvale Rd Tunnel	No Project	$2,272,979					
E7: Construct Additional Tunnel along Saratoga-Sunnyvale Rd Tunnel				$3,045,860	$3,045,860		
E8: Replace Saratoga-Sunnyvale Tunnel by (9' x 24')			$3,628,912			$3,628,912	
E9: Construct Levee / Floodwall upstream Saratoga-Sunnyvale Rd Tunnel		$163,194 / $150,410	$163,194 / $150,410	$163,194 / $150,410	$163,194 / $150,410	$163,194 / $150,410	
E10: Replace UPRR Culvert by (6' x 23')				$1,972,849	$1,972,849	$1,972,849	
E11: Construct Levee / floodwall u/s of UPRR				$112,469 / $60,149	$112,469 / $60,149	$112,469 / $60,149	
E12: Construct a Bypass Pipe along Creek Bank at UPRR		$2,413,237	$2,413,237				
E13: Non-Structural (Flood Proofing)							$19,484,375
Total Capital Cost		$5,371,654 $5,437,912	$6,727,586 $6,793,844	$5,816,615 $5,830,553	$5,716,693 $5,849,897	$6,399,667 $6,413,605	19,484,375

E 1 - Construction of Levee/Floodwall at Calabazas Park

Length = 400 feet

LEVEE

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.17	Acre	$ 5,500	$ 935
Earth Work				
Soil embankment	414.81	C.Y.	$ 25	$ 10,370
Miscellaneous				
Fencing	400.00	L.F.	$ 15	$ 6,000
SUBTOTAL				**$ 17,305**
Mobilization (10%)				$ 1,703
Construction Contingencies (15%)				$ 2,555
TOTAL CONSTRUCTION				**$ 21,563**
Planning (10)				$ 2,129
Design (20%)				$ 4,258
Geotechnical (5%)				$ 1,065
Inspection (10%)				$ 2,129
R/W COSTS				
TOTAL COSTS				**$ 31,144**

FLOODWALL

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.08	Acre	$ 5,500	$ 457
Floodwall				
Concrete volume	133.33	C.Y.	$ 550	$ 73,332
Earth Work				
Soil excavation	133.33	C.Y.	$ 25	$ 3,333
Miscellaneous				
Fencing	400.00	L.F.	$ 15	$ 6,000
SUBTOTAL				**$ 83,121**
Mobilization (10%)				$ 8,282
Construction Contingencies (15%)				$ 12,423
TOTAL CONSTRUCTION				**$ 103,826**
Planning (10)				$ 10,352
Design (20%)				$ 20,704
Geotechnical (5%)				$ 5,176
Inspection (10%)				$ 10,352
R/W COSTS				
TOTAL COSTS				**$ 150,410**

E 2 - Widening channel at Calabazas Park

Length =600 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.28	Acre	$ 5,500	$ 1,540
Earth Work				
Soil excavation	2,222	C.Y.	$ 28	$ 62,222
Miscellaneous				
Fencing	570	L.F.	$ 15	$ 8,550
SUBTOTAL				**$ 72,312**
Mobilization (10%)				$ 7,231
Construction Contingencies (15%)				$ 10,847
TOTAL CONSTRUCTION				**$ 90,390**
Planning (10)				$ 9,039
Design (20%)				$ 18,078
Geotechnical (5%)				$ 4,520
Inspection (10%)				$ 9,039
R/W COSTS				
TOTAL COSTS				**$ 131,066**

E 3 - Construction of levee/floodwall u/s and d/s of Foot Bridge

Length = 500 feet

LEVEE

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.22	Acre	$ 5,500	$ 1,210
Earth Work				
Soil embankment	518.52	C.Y.	$ 25	$ 12,963
Miscellaneous				
Fencing	500	L.F.	$ 15	$ 7,500
SUBTOTAL				**$ 21,673**
Mobilization (10%)				$ 2,129
Construction Contingencies (15%)				$ 3,193
TOTAL CONSTRUCTION				**$ 26,995**
Planning (10)				$ 2,661
Design (20%)				$ 5,322
Geotechnical (5%)				$ 1,331
Inspection (10%)				$ 2,661
R/W COSTS	1400	S.F.	$ 50	$ 70,000
TOTAL COSTS				**$ 108,970**

FLOODWALL

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.10	acre	$ 5,500	$ 567
Floodwall				
Concrete volume	166.67	C.Y.	$ 550	$ 91,669
Earth Work				
Soil excavation	166.67	C.Y.	$ 25	$ 4,167
Miscellaneous				
Fencing	500	L.F.	$ 15	$ 7,500
SUBTOTAL				**$ 103,902**
Mobilization (10%)				$ 10,352
Construction Contingencies (15%)				$ 15,528
TOTAL CONSTRUCTION				**$ 129,782**
Planning (10)				$ 12,940
Design (20%)				$ 25,880
Geotechnical (5%)				$ 6,470
Inspection (10%)				$ 12,940
R/W COSTS				
TOTAL COSTS				**$ 188,012**

E 4 - Raising Existing Foot Bridge

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing		Acre	$ 55,000	
Demolish	1	L.S.	$ 50,000	$ 50,000
Rebuilt new one	1	L.S.	$ 105,000	$ 105,000
Miscellaneous				
Fencing		L.F.		
Traffic Control		L.S.		$ 700
SUBTOTAL				**$ 155,700**
Mobilization (10%)				$ 15,570
Construction Contingencies (15%)				$ 23,355
TOTAL CONSTRUCTION				**$ 194,625**
Planning (10)				$ 19,463
Design (20%)				$ 38,925
Geotechnical (5%)				$ 9,732
Inspection (10%)				$ 19,463
R/W COSTS				
TOTAL COSTS				**$ 282,208**

E 5 - Relocation of Foot Bridge

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing		Acre	$ 55,000	
Demolish	1	L.S.	$ 50,000	$ 50,000
Rebuilt new one	1	L.S.	$ 105,000	$ 105,000
Miscellaneous				
Fencing		L.F.		
Traffic Control		L.S.		$ 700
SUBTOTAL				**$ 155,700**
Mobilization (10%)				$ 15,570
Construction Contingencies (15%)				$ 23,355
TOTAL CONSTRUCTION				**$ 194,625**
Planning (10)				$ 19,463
Design (20%)				$ 38,925
Geotechnical (5%)				$ 9,731
Inspection (10%)				$ 19,463
R/W COSTS				
TOTAL COSTS				**$ 282,207**

E 6 - Construction of Bypass Pipe along Saratoga-Sunnyvale Rd Tunnel

Length = 753 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.26	Acre	$ 5,500	$ 1,430
Bypass Pipe				
Concrete volume	700.57	C.Y.	$ 550	$ 385,314
Utility Replacement/Protection/Modification		L.S.		$ 250,000
Earth Work				
Soil excavation	5020.00	C.Y.	$ 25	$ 125,500
Soil embankment	3247.00	C.Y.	$ 25	$ 81,175
Shoring	18072.00	S.F.	$ 26	$ 469,872
Asphalt Replacement	62.75	C.Y.	$ 11	$ 690
Miscellaneous				
Fencing	753.00	L.F.	$ 15	$ 11,295
Traffic Control		LS		$ 75,300
SUBTOTAL				**$ 1,400,576**
Mobilization (10%)				$ 107,372
Construction Contingencies (15%)				$ 161,059
TOTAL CONSTRUCTION				**$ 1,669,007**
Planning (10)				$ 134,216
Design (20%)				$ 268,432
Geotechnical (5%)				$ 67,108
Inspection (10%)				$ 134,216
R/W COSTS				
TOTAL COSTS				**$ 2,272,979**

E 7 - Construction of Additional Tunnel along Saratoga-Sunnyvale Rd Tunnel

Length = 683 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.30	Acre	$ 5,500	$ 1,650
Tunnel				
Concrete volume	1265.00	C.Y.	$ 550	$ 695,750
Earth Work				
Soil excavation	6729.00	C.Y.	$ 25	$ 168,225
Soil embankment	1214.22	C.Y.		
Shoring	19124.00	S.F.	$ 26	$ 497,224
Utility Replacement/Protection/Modification		L.S.		$ 250,000
Asphalt Replacement	101.20	C.Y.	$ 11	$ 1,113
Miscellaneous				
Fencing	683.00	L.F.	$ 15	$ 10,245
Traffic Control		L.S.		$ 68,300
SUBTOTAL				**$ 1,692,507**
Mobilization (10%)				$ 166,567
Construction Contingencies (15%)				$ 249,850
TOTAL CONSTRUCTION				**$ 2,108,924**
Planning (10)				$ 208,208
Design (20%)				$ 416,416
Geotechnical (5%)				$ 104,104
Inspection (10%)				$ 208,208
R/W COSTS				
TOTAL COSTS				**$ 3,045,860**

E 8 - Replacement of Saratoga-Sunnyvale Tunnel

Length = 683 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.50	Acre	$ 5,500	$ 2,750
Tunnel				
Concrete volume	1770.74	C.Y.	$ 550	$ 973,907
Concrete excavation	1366.00	C.Y.	$ 25	$ 34,150
Utility Replacement/Protection/Modification		L.S.		$ 250,000
Earth Work				
Soil excavation	4604.00	C.Y.	$ 25	$ 115,100
Soil embankment	2124.89	C.Y.	$ 25	$ 53,122
Shoring	19124.00	S.F.	$ 26	$ 497,224
Asphalt Replacement	177.00	C.Y.	$ 11	$ 1,947
Miscellaneous				
Fencing	683.00	L.F.	$ 15	$ 10,245
Traffic Control		L.S.		$ 68,300
SUBTOTAL				**$ 2,006,745**
Mobilization (10%)				$ 199,652
Construction Contingencies (15%)				$ 299,477
TOTAL CONSTRUCTION				**$ 2,505,874**
Planning (10)				$ 249,564
Design (20%)				$ 499,128
Geotechnical (5%)				$ 124,782
Inspection (10%)				$ 249,564
R/W COSTS				
TOTAL COSTS				**$ 3,628,912**

E 9 - Construction of levee/floodwall u/s Saratoga-Sunnyvale Rd Tunnel

Length = 400 feet

LEVEE

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.17	Acre	$ 5,500	$ 935
Earth Work				
Soil embankment	414.81	C.Y.	$ 25	$ 10,370
Miscellaneous				
Fencing	400.00	L.F.	$ 15	$ 6,000
SUBTOTAL				**$ 17,305**
Mobilization (10%)				$ 1,703
Construction Contingencies (15%)				$ 2,555
TOTAL CONSTRUCTION				**$ 21,563**
Planning (10)				$ 2,129
Design (20%)				$ 4,258
Geotechnical (5%)				$ 1,065
Inspection (10%)				$ 2,129
R/W COSTS	2641.00	S.F.	$ 50.00	$ 132,050
TOTAL COSTS				**$ 163,194**

FLOODWALL

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.08	Acre	$ 5,500	$ 457
Floodwall				
Concrete volume	133.33	C.Y.	$ 550	$ 73,332
Earth Work				
Soil excavation	133.33	C.Y.	$ 25	$ 3,333
Miscellaneous				
Fencing	400.00	L.F.	$ 15	$ 6,000
SUBTOTAL				**$ 83,121**
Mobilization (10%)				$ 8,282
Construction Contingencies (15%)				$ 12,423
TOTAL CONSTRUCTION				**$ 103,826**
Planning (10)				$ 10,352
Design (20%)				$ 20,704
Geotechnical (5%)				$ 5,176
Inspection (10%)				$ 10,352
R/W COSTS				
TOTAL COSTS				**$ 150,410**

E 10 - Replacement of UPRR Culvert

Length = 40 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.03	Acre	$ 5,500	$ 165
Culvert				
Concrete volume	91.85	C.Y.	$ 550	$ 50,518
Concrete excavation	62.22	C.Y.	$ 25	$ 1,556
Shoofly				$ 1,000,000
Earth Work				
Soil excavation	277.00	C.Y.	$ 25	$ 6,925
Soil embankment	115.56	C.Y.	$ 25	$ 2,889
Shoring	880.00	S.F.	$ 26	$ 22,880
Asphalt Replacement		C.Y.		
Miscellaneous				
Fencing	40.00	L.F.	$ 15	$ 600
Traffic Control		L.S.		$ 4,000
SUBTOTAL				**$ 1,089,532**
Mobilization (10%)				$ 108,716
Construction Contingencies (15%)				$ 163,073
TOTAL CONSTRUCTION				**$ 1,361,321**
Planning (10)				$ 135,895
Design (20%)				$ 271,790
Geotechnical (5%)				$ 67,948
Inspection (10%)				$ 135,895
R/W COSTS				
TOTAL COSTS				**$ 1,972,849**

E 11 - Construction of levee/floodwall u/s UPRR on top of both banks

Length = 80 feet * 2 = 160 feet

LEVEE

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.07	Acre	$ 5,500	$ 385
Earth Work				
Soil embankment	165.93	C.Y.	$ 25	$ 4,148
Miscellaneous				
Fencing	160.00	L.F.	$ 15	$ 2,400
SUBTOTAL				**$ 6,933**
Mobilization (10%)				$ 681
Construction Contingencies (15%)				$ 1,022
TOTAL CONSTRUCTION				**$ 8,636**
Planning (10)				$ 852
Design (20%)				$ 1,703
Geotechnical (5%)				$ 426
Inspection (10%)				$ 852
R/W COSTS	2000.00	S.F.	$ 50.00	$ 100,000
TOTAL COSTS				**$ 112,469**

FLOODWALL

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.03	Acre	$ 5,500	$ 165
Floodwall				
Concrete volume	53.33	C.Y.	$ 550	$ 29,332
Earth Work				
Soil excavation	53.33	C.Y.	$ 25	$ 1,333
Miscellaneous				
Fencing	160.00	L.F.	$ 15	$ 2,400
SUBTOTAL				**$ 33,230**
Mobilization (10%)				$ 3,313
Construction Contingencies (15%)				$ 4,969
TOTAL CONSTRUCTION				**$ 41,512**
Planning (10)				$ 4,141
Design (20%)				$ 8,281
Geotechnical (5%)				$ 2,070
Inspection (10%)				$ 4,141
R/W COSTS				
TOTAL COSTS				**$ 60,145**

E 12 - Construction of Bypass Pipe along creek bank at UPRR

Length = 180 feet

Item	Quantities	Unit	Unit Costs	Amount
Site Preparation				
Clearing and grubbing	0.06	Acre	$ 5,500	$ 330
Culvert				
Concrete volume	146.53	C.Y.	$ 550	$ 80,592
Shoofly				$ 1,000,000
Earth Work				
Soil excavation	1027.00	C.Y.	$ 25	$ 25,675
Soil embankment	692.00	C.Y.		
Shoring	3960.00	S.F.	$ 26	$ 102,960
Asphalt Replacement		C.Y.		
Utilities				$ 20,000
Miscellaneous				
Fencing	180.00	L.F.	$ 15	$ 2,700
Traffic Control		L.S.		$ 68,300
SUBTOTAL				**$ 1,300,557**
Mobilization (10%)				$ 124,637
Construction Contingencies (15%)				$ 186,956
TOTAL CONSTRUCTION				**$ 1,612,150**
Planning (10)				$ 155,797
Design (20%)				$ 311,594
Geotechnical (5%)				$ 77,899
Inspection (10%)				$ 155,797
R/W COSTS	2000	S.F.	$ 50.00	$ 100,000
TOTAL COSTS				**$ 2,413,237**

E 13 - None Structural (Flood Proofing)

Number of Homes = ~ 2500

Item	Quantities	Unit	Unit Costs	Amount
Flood Proofing				
Number of Homes	2500	Each	$ 2,500.00	$ 6,250,000.00
Miscellaneous				
Fencing		L.F.	$ 15	
Traffic Control		L.S.		
SUBTOTAL				$ 6,250,000.00
Mobilization (10%)				$ 6,250,000
Construction Contingencies (15%)				$ 937,500
TOTAL CONSTRUCTION				$ 13,437,500
Planning (10)				$ 1,343,750
Design (20%)				$ 2,687,500
Geotechnical (5%)				$ 671,875
Inspection (10%)				$ 1,343,750
R/W COSTS				
TOTAL COSTS				$ 19,484,375

CALABAZAS CREEK
MILLER TO COMER PROJECT
Yearly Maintenance Cost Estimation
Alternative A

Item	Unit Cost	Unit	Quantity	Amount
I. Clearing & Grubbing				
• Trash and debris removal	$70	Hour	30	$2,100
• Graffiti removal	$70	Hour	30	$2,100
II. Vegetation Control				
• Vegetation overgrowth control	$70	Hour	30	$2,100
• Tree work	$100	Hour	30	$3,000
III. Channel Restoration				
• Invasive species removal (by hand)	$60	Hour	30	$1,800
• Native species implementation	$70	Hour	30	$2,100
IV. Erosion Control				
• Rock protection	$100	Hour	100	$10,000
• Seeding and mulching	$60	Hour	30	$1,800
V. Sediment removal				
• Sediment removal	$100	Hour	200	$20,000
VI. Miscellaneous Work				
• Fencing	$60	Hour	50	$3,000

Subtotal	$48,000
Mobilization (10%)	$4,800
Contingency (5%) (i.e. extra work, permitting)	$2,400
Annual Maintenance Costs	**$55,200**

Notes:

1. The preliminary option of probable maintenance costs should be used as a guide only.
2. There is a fluctuation in cost of quantity, material, labor or other components.
3. The maintenance program will be performed under Routine Maintenance Activities.
4. Rock protection is assumed to use routine repair and maintenance only.

CALABAZAS CREEK
MILLER TO COMER PROJECT
Yearly Maintenance Cost Estimation
Alternative B to F

Item	Unit Cost	Unit	Quantity	Amount
I. Clearing & Grubbing				
• Trash and debris removal	$70	Hour	30	$2,100
• Graffiti removal	$70	Hour	50	$3,500
II. Vegetation Control				
• Vegetation overgrowth control	$70	Hour	30	$2,100
• Tree work	$100	Hour	30	$3,000
III. Channel Restoration				
• Invasive species removal (by hand)	$60	Hour	30	$1,800
• Native species implementation	$70	Hour	30	$2,100
IV. Erosion Control				
• Rock protection	$100	Hour	30	$3,000
• Seeding and mulching	$60	Hour	30	$1,800
V. Sediment removal				
• Sediment removal	$100	Hour	140	$14,000
VI. Miscellaneous Work				
• Fencing	$60	Hour	50	$3,000
Subtotal				$36,400
Mobilization (10%)				$3,640
Contingency (5%) (i.e. extra work, permitting)				$1,820
Annual Maintenance Costs				**$41,860**

Notes:

1. The preliminary option of probable maintenance costs should be used as a guide only.
2. There is a fluctuation in cost of quantity, material, labor or other components.
3. The maintenance program will be performed under Routine Maintenance Activities.
4. Rock protection is assumed to use routine repair and maintenance only.

P:\Calabazas Creek - Miller to Wardell\Work Space\Planning\Alternatives\Conceptual Alternatives\Report Text\05 - Attach B - flood costs\Cost Estimation-yearly maintenance.xls
WY (Revised 02/17/06)

Attachment C

Comer Debris Basin Modification
Conceptual Cost Analysis

TABLE I.1. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 2 KENNEDY/JENKS CONSULTANTS

Project: Comer Debris Basin Engineering Feasibility Study

Prepared By: NEN/MHM
Date Prepared: 4/9/2002
K/J Proj. No. 015314.00

Building, Area: Alternative 2, Headwall Demo, Uniform Slope

Current at ENR
Escalated to ENR

Estimate Type:
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials		Installation		Sub-contractor		Total
					$/Unit	Total	$/Unit	Total	$/Unit	Total	
	1	Planning: CEQA	1	LS					$60,000	$60,000	$60,000
	2	Permitting	1	LS					$40,000	$40,000	$40,000
	3	Pre-Design/Design/Constr. Support	1	LS					$150,000	$150,000	$150,000
	4	Concrete Demo	120	CY			$400.00	$48,000			$48,000
	5	Sediment Excavation	11,500	CY					$25.00	$288,000	$288,000
	6	Stream Restoration/Reveg/Grading	1	LS					$250,000	$250,000	$250,000
		Subtotals				$0		$48,000		$788,000	$836,000
		Taxes	@	7.75%				$3,720		$61,070	$64,790
		Subtotals									$900,790
		Contractor OH&P	@	15%				$7,200		$118,200	$125,400
		Subtotals									$1,026,190
		Contingency	@	25%				$12,000		$197,000	$209,000
		Estimated Bid Cost									$1,235,190
		Engineering (see Item 3)	@	0%							$0
		Total Estimate									$1,235,190

Estimate accuracy is +50% to -30%

4/18/2002 9:23 AM

TABLE I.2. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 3

KENNEDY/JENKS CONSULTANTS

Project: Comer Debris Basin Engineering Feasibility Study

Building, Area: Alternative 3, Headwall Demo, Stepped Channel

Prepared By: NEN/MHM
Date Prepared: 4/9/2002
K/J Proj. No. 015014.00

Current at ENR
Escalated to ENR

Estimate Type:
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	1	Planning: CEQA	1	LS					$60,000	$60,000	$60,000
	2	Permitting	1	LS					$40,000	$40,000	$40,000
	3	Pre-Design/Design/Constr. Support	1	LS					$150,000	$150,000	$150,000
	4	Concrete Demo	120	CY			$400.00	$48,000			$48,000
	5	Sediment Excavation	4,000	CY					$25.00	$100,000	$100,000
	6	Stream Restoration/Reveg/Grading	1	LS					$200,000	$200,000	$200,000

			Materials	Installation	Sub-contractor	Total
Subtotals			$0	$48,000	$550,000	$598,000
Taxes	@	7.75%		$3,720	$42,625	$46,345
Subtotals						$644,345
Contractor OH&P	@	15%		$7,200	$82,500	$89,700
Subtotals						$734,045
Contingency	@	25%		$12,000	$137,500	$149,500
Estimated Bid Cost						$883,545
Engineering (see item 3)	@	0%				$0
Total Estimate						$883,545

Estimate accuracy is +50% to -30%

TABLE I.3. ENGINEER'S CONCEPTUAL ESTIMATE OF PROBABLE DESIGN/CONSTRUCTION COSTS - ALTERNATIVE 4

KENNEDY/JENKS CONSULTANTS

Project: Corner Debris Basin Engineering Feasibility Study

Building, Area: Alternative 4, Partial Headwall Demo, Limited Excavation

Prepared By: NEN/MHM
Date Prepared: 4/9/2002
K/J Proj. No. 015014.00

Current at ENR
Escalated to ENR

Estimate Type:
☒ **Conceptual**
☐ **Preliminary (w/o plans)**
☐ **Design Development @**
☐ **Construction**
☐ **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
	1	Planning: CEQA	1	LS					$60,000	$60,000	$60,000
	2	Permitting	1	LS					$40,000	$40,000	$40,000
	3	Pre-Design/Design/Constr. Support	1	LS					$150,000	$150,000	$150,000
	4	Concrete Demo	16	CY			$400.00	$6,400			$6,400
	5	Sediment Excavation	1,600	CY					$25.00	$40,000	$40,000
	6	Stream Restoration/Reveg/Grading	1	LS					$100,000	$100,000	$100,000
		Subtotals				$0		$6,400		$390,000	$396,400
		Taxes	@	7.75%				$496		$30,225	$30,721
		Subtotals									$427,121
		Contractor OH&P	@	15%				$960		$58,500	$59,460
		Subtotals									$486,581
		Contingency	@	25%				$1,600		$97,500	$99,100
		Estimated Bid Cost									$585,681
		Engineering (see item 3)	@	0%							$0
		Total Estimate									$585,681

Estimate accuracy is +50% to -30%

Table I.4
Comer Debris Basin Feasibility Study
Engineer's Conceptual Estimate of Probable O & M Costs

O&M Costs	Unit	Alternative 2	 3	 4
Crew Rate[1]	day[2]	$ 2,720.00	$ 2,720.00	$ 2,720.00
No. of Visits/Year[3]		2	4	2
Subtotal Maintenance		$ 5,440.00	$ 10,880.00	$ 5,440.00
Biology/Habitat Monitoring[4]	day[5]	$ 760.00	$ 760.00	$ 760.00
No. of Visits/Year		12	12	12
Subtotal Monitoring		$ 9,120.00	$ 9,120.00	$ 9,120.00
Total Annual O & M		**$ 14,560.00**	**$ 20,000.00**	**$ 14,560.00**

Notes
1) Maint. crew assumed to consist of 4 personnel @ $85/hr ea.(incl overhead) w/2 pickups, tools.
2) Assume an 8 hour day for each maintenance visit
3) Alt. 3 - Assume 1 visit/mo April - Oct, and two visits/mo Nov-March
4) Monitoring crew assumed to consist of single biologist @ $95/hr (incl overhead).
5) Assume 8 hour day for each monitoring visit, including report prep.

Attachment D

Biological Resources
for
Calabazas Miller to Wardell

Biological Resources for the Calabazas Miller to Wardell Conceptual Alternatives Screening Report

Flood Control Alternatives

Elements that have been proposed to meet the flood control objectives of the Calabazas Miller to Wardell Project include: levee construction, floodwall construction, channel widening, removal and replacement of a footbridge, and placement of a bypass pipe. There are impacts to biological resources that are common to all of these elements. Short-term construction related impacts, both direct and indirect, would occur; these may include short-term vegetation impacts, disturbance of aquatic species resulting from dewatering, disturbance of other wildlife due to riparian and upland work, and disturbance of nesting birds.

More long-term or even permanent impacts to biological resources would also result from all of the proposed flood control elements. Direct mortality of aquatic or other wildlife could occur as a result of construction activities. In addition, with each alternative, there exists the potential for loss or degradation of upland, riparian, wetland, and aquatic habitats; which, in turn, would translate to impacts to the wildlife communities those habitats support. Vegetation removal, in general, would result in habitat reduction and fragmentation and the loss of foraging, breeding, and roosting habitat for common wildlife species. Riparian, wetland and aquatic habitats are considered more valuable ecologically (in part because specifically adapted wildlife species depend on them), so alternatives with fewer impacts to these particular vegetation types would be preferred. Healthy riparian habitat is critical to maintaining biological diversity, especially in areas such as Calabazas Creek where the upland habitat has been intensively modified for urban uses.

Habitat fragmentation coupled with the separation of riparian habitat from adjacent upland dispersal habitat would have a deleterious effect on biological resources. The project flood control elements most closely associated with fragmentation and barriers to dispersal are floodwalls and levees. In general, any alteration of riparian corridors is likely to result in habitat fragmentation, thus reducing the area that can be used for foraging, growth, and reproduction of wildlife. Because fragmented habitats are able to support smaller populations of animals, the populations become more vulnerable to being locally extirpated. Levees and floodwalls result in additional adverse effects by acting as an actual physical barrier separating some types of wildlife (i.e. native amphibians) from necessary upland habitats.

Flow alterations in the creek could also affect biological resources. The construction of floodwalls and the raising or building of levees could result in additional flow downstream of the project area or possibly increasing the amount of water in the creek's tributaries (backwater effects). More water could better support biological resources such as native fish and amphibians; over time, water in areas that previously went dry could support wetland and riparian habitats where they did not previously exist. On the other hand, higher flows and water surface elevations could also result in flooding and erosion, degrading the habitat. The placement of a bypass pipe has the potential to reduce the flow in the natural channel, which could impact wetland and riparian habitat as well as breeding amphibians and native fish.

In summary, all of the elements proposed as flood control measures under the Calabazas Miller to Wardell Project would likely result in direct and indirect, as well as permanent and temporary, impacts to local biological resources. However, the extent and types of vegetation to be removed, degree of habitat fragmentation and barriers to dispersal, and flow alterations in the creek would all have bearing on the severity of these impacts. Therefore, these measures could be used when screening flood control methods for their effects on biological resources.

Erosion Protection Alternatives

Screening of the erosion protection elements of project alternatives relative to biological resources would involve the amount of in-stream or streamside hardscape that would be added to the project area. In-stream hardscape adversely affects aquatic habitat while streamside hardscape impacts riparian habitat. Elements that have been proposed in order to meet the Calabazas Miller to Wardell project's erosion protection elements include boulder toe covered with vegetation, crib walls, live log slope protection, and root wad with footer. All four of these erosion protection alternatives are categorized as mixed construction. Mixed construction consists of structural or mechanical methods using plant materials combined with inert materials. For biological resources, mixed construction methods are preferred over strictly inert construction. However, live construction provides the best habitat value. The minimization of hardscape in bank protection design is encouraged. Preferred repair would be designed and installed to be self-sustaining and use vegetation to add structural integrity to the stream bank. Therefore, in comparing erosion protection elements and their impacts to biological resources, the amount of live construction (softscape) versus inert construction (hardscape) would be the best screening measure.

Habitat Restoration and Enhancement Alternatives

There are habitat restoration or enhancement elements that could be built into project alternatives to benefit biological resources. Possible restoration elements include the removal of non-native vegetation, planting of native species, the creation of in-stream structures for habitat complexity, and the modification of Comer debris basin. The non-native invasive vegetation currently growing within the project reach could be removed and replaced with native vegetation. Introduced plants can decrease the value of riparian habitats; most exotic invasive vegetation displaces native flora and provides suboptimal habitat for native wildlife. Subsequent planting or recruitment of native vegetation would result in the enhancement of formerly degraded areas. The improved riparian corridor would provide better foraging, breeding, and resting habitat for riparian associated and riparian dependent wildlife, as well as serving as a crucial movement corridor (given the extent of urbanization in the area). An additional enhancement element, the creation of instream structures, would increase habitat complexity and benefit aquatic species. The modification of Comer debris basin would also benefit biological resources by reducing the amount of in-stream hardscape and improving the area's function as a movement corridor for wildlife.

Reference

1. Kennedy/Jenks consultants: Comer Debris Basin Engineering Feasibility Study Final Report, April, 2002

APPENDIX

DISTRICT POLICY FOR FLOOD CONTROL MAINTENANCE OF PRIVATE PROPERTY

(Engineering Policy 3-330)

ENGINEERING POLICIES & PROCEDURES

Santa Clara Valley Water District

Policy: 3-330
Page: 1 of 1
Date: September 16, 1994
Coordinator: 06230, 07100

SUBJECT: DISTRICT FLOOD CONTROL MAINTENANCE OF PRIVATE PROPERTY

I. TITLE

District Flood Control Maintenance of Private Property

II. BACKGROUND

This policy is based on District Ordinance 83-2, Section 5 (Engineering Policies and Procedures 1-310).

III. POLICY

The District will not perform flood control maintenance work on any facility where it does not have right of way for such facility. Maintenance work of a permanent nature on private land would constitute spending public funds to improve private property. An exception to this practice is to provide needed maintenance work in an emergency situation.*

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*Cross Reference: See Engineering Policies & Procedures 1-356, "Right of Way Dedication—Field Personnel Response."